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KENYA JOURNAL OF INTEGRATED RESEARCH, INNOVATIONS & ENTREPRENEURSHIP

The Kisumu National Polytechnic (TKNP) is a premier National Polytechnic in Kenya situated within the Lake city of Kisumu, approximately 349Km from the Capital city of Kenya; Nairobi. TKNP began operations in 1967 as a technical secondary school. In 1988, the Ministry upgraded the institution to a Technical Training Institute, 1996, the Ministry further upgraded the Technical Training Institute into a National Polytechnic to cater for the regional demand for technical skills. On 22nd August, 2014 in response to section 26 (2) of the Technical and Vocational Education and Training Act of 2013, the Cabinet Secretary for Education Science and Technology promulgated the Kisumu National Polytechnic Order, 2014 with a wider mandate to among other;

- Provide directly, or in collaboration with other institutions of higher learning, facilities for technical trainers in technological, professional and scientific education;
- Participate in technological innovation as well as in the discovery, transmission and enhancement of knowledge and to stimulate the intellectual life in the economic, social cultural, scientific, and technological development;
- Contribute to industrial and technological development of Kenya in collaboration with industry and other organizations through transfer of technology;
- Promote and establish a culture of innovation in engineering and technology, and technology transfer amongst staff and students;
- Develop an institution with excellence in teaching, training, scholarship, entrepreneurship, research, consultancy, community service, among other educational services and products, with emphasis on technology and its development, impact and application within and outside Kenya;

The institution through KJ-IRIE plans to create the synergy needed to find innovative solutions to societal problems by advancing knowledge and its practical application by research and other means, the dissemination of outcomes of research by various means, and the commercial exploitation of research results.

WORD FROM THE EDITOR

Dear readers,

Welcome to the 1st edition of our multidisciplinary journal. It is with great pleasure that I present to you a collection of insightful articles and research papers that delve into the diverse realms of knowledge and discovery. In this issue, we aim to embrace the interdisciplinary nature of academia and explore the intersections between various fields of study.

As the Editor of this journal, I am constantly inspired by the remarkable work of our contributors who continuously push the boundaries of their respective disciplines. The articles presented in this edition exemplify the spirit of collaboration and the power of merging ideas from different domains to foster innovation and advance our understanding of the world.

This issue covers an array of topics, ranging from social sciences to natural sciences, from humanities to technology, and beyond. We explore the intricate dynamics of human behavior, the impact of climate change on ecosystems, the development of cutting-edge technologies, and the exploration of historical narratives. Each article represents a unique contribution to its respective field, showcasing the intellectual prowess and dedication of our authors.

I would like to express my gratitude to the authors for their invaluable contributions and for embracing the multidisciplinary ethos of our journal. Their tireless efforts in conducting research, analyzing data, and crafting thought-provoking narratives have enriched this publication and contribute to the broader academic community.

Additionally, I would like to acknowledge the reviewers and editorial team whose expertise and commitment ensure the quality and rigor of the articles presented. Their thorough evaluations and constructive feedback play a pivotal role in maintaining the high standards of our journal.

To our readers, I encourage you to delve into the pages of this edition and immerse yourselves in the intellectual feast that awaits you. Explore the connections between disciplines, challenge conventional wisdom, and embrace the transformative power of multidisciplinary collaboration.

Thank you for your continued support and engagement with our multidisciplinary journal. I hope you find this issue both enlightening and inspiring.

Warm regards,

Dr Asaka Nyangara

CHIEF EDITOR

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ENVIRONMENTAL SUSTAINABILITY

AN ASSESSMENT OF THE EFFECTIVENESS OF SOLID WASTE DISPOSAL METHODS FOR A CLEAN ENVIRONMENT: A CASE STUDY OF HURUMA ESTATE IN NAIROBI COUNTY

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ABSTRACT

Poor Solid waste management is a threat to human health and the environment. Rapid industrial development and urbanization have seen a rise in urban population which translates to massive production of solid waste. Though most urban and city planners have adopted new technologies such as landfills and incineration, these alone cannot work without training residents on best practices that will guide them on how to manage their waste. The purpose of the study was to determine the effectiveness of solid waste disposal methods in Huruma estate, Nairobi County at as a means of achieving a clean environment. The study aimed to determine the methods and frequency used and the role of the community in solid waste disposal. The study adopted cross-sectional research design and survey approach for data collection using questionnaires. A total of 44 respondents were randomly selected from a population of 50 residents from the area whom the questionnaires were administered to collect data. Secondary data was obtained through the review of relevant publications and journals. Data was analyzed using statistical package for social science (SPSS) and presented using tables and graphs. Results obtained showed that 48 percent of the residents discard waste along the road and the remaining 52 percent put waste in dustbins. Moreover it was revealed that residents lack awareness regarding solid waste disposal methods and the community was ignoring their role in solid waste disposal. From the results obtained, it was noted that challenges of waste disposal were; irregular waste collection, illegal dumping and low levels of waste disposal methods awareness. The study recommended that the government should promote solid waste disposal trainings and enforce the concerned environmental laws. Further research should be done on the effects poor waste disposal on the environment.

Keywords: Solid waste, Disposal, Dumping, effectiveness, environment.

INTRODUCTION

Solid waste disposal is affecting people globally in that the poorly disposed waste is contaminating the world's oceans, clogging drains and causing flooding, transmitting diseases, respiratory problems from burning harming animals that consume waste unknowingly and affecting economic development such as through tourism. (Ref Sameh Wanna, world bank Director).In the context of regional solid waste disposal the low income countries over 90% of waste is often disposed in unregulated dumps or openly burned areas. Practices create serious health problems, safety and environmental consequences to the residences. (World Bank 2019).

The solid waste disposal method is also affecting people locally as some wastes eventually rot but not all and in the process it may smell or generate methane gas which is explosive and contributes to the greenhouse effect and also the residents suffer from medical conditions such as Asthma, cuts, Diarrhea, stomach pain, reoccurring flu, cholera, malaria, cough, skin irritation.15 June 2019. In Huruma estate improper waste disposal is a deadly practice that is soil, water and air pollution can all be a result of improper waste disposal and occurs when either of them becomes contaminated with hazardous materials.

The solid waste are distributed at the area in Huruma estate hence polluting the environment because some wastes cannot decompose like the plastics thus making the area dirty and unhygienic due to a lot of illegal dumping of solid wastes in the area. The wastes attracts rats and flies and also wind shifts brings an odorous smell to offend residents living close to the dump and the open air burning smoke affects the residents health by causing respiratory diseases that is why the study is focusing on determining the effectiveness of solid waste disposal methods in Huruma Estate, Nairobi County. The benefits of the study were to give information by educating the residence on the importance of solid waste disposal methods i.e. through recycling, incineration and landfilling. Also contribute to knowledge on how the methods can help to avoid diseases and other unpredicted problems. The beneficiaries will be the residents living in Huruma estate, Nairobi County who are facing the challenges brought by the open solid wastes and also to provide solution for the existing problem that is the proper methods for solid waste disposal in the area. The study also provided information to be used as reference by future researchers in the area on issues solid waste management.

LITERATURE REVIEW

According to ETM recycling September 23rd 2020, creation of waste is inevitable for every person and business across all sectors, including residential, commercial, Industrial, agriculture and more. The number one dilemma wastes presents how to dispose of it, hence why effective waste disposal is so critical. Disposing of wastes produced in the UK is a huge logistic task, comprising of local

Over the years of waste created by humans, waste disposal methods have changed, for example, centuries ago waste should be rudimentarily buried as the population was small and waste was highly biodegradable. Landfill is similar to this antiqued disposal method. However now this is not an option: modern waste is not easily biodegradable, the amount is too large and ecosystems get damaged.

Methods to overcome the above issues include reuse and recycling which helps to mitigate the harmful effects of waste by reducing the amount that ends up in landfill. Recycling conserves natural resources and reduces energy demands(for making virgin materials).Many materials can be recycled, which contributes to it being a popular effective waste disposal method, including plastic and oil and some can be recycled infinity i.e glass or paper.

In solid waste landfilling 2018, Solid waste disposal sites, ranging from open dumps to sanitary landfills as such cannot be considered a sustainable option for waste management. During waste deposition, closure and post-closure emissions are generated that do have a negative impact on the environment and potentially represent a threat to human health. Landfills give rise to air and water pollution which severely affects the environment and can prove fatal to the lives of human and animals. Incinerators are primarily used in thermal treatment where solid waste materials are converted to heat gas, steam and ash. Incineration is also widely popular in countries where landfill space is no longer available, such as the US and Japan.

Recycling is the process of converting waste products into new products to prevent energy usage and consumption of fresh raw materials. Recycling is the third component of reduce, reuse and recycle waste hierarchy. The idea behind recycling is to reduce energy usage, reduce the volume of landfills reduce air and water pollution, reduce greenhouse gas emissions and preserve natural resources for future use. Composting involves the decomposition of organic wastes by microbes by allowing the waste to stay accumulated in a pit for a long period of time. The nutrient-rich compost can be used as plant manure. However, the process is slow and consumes a significant amount of land. Biological reprocessing tremendously improves the fertility of the soil. As and natural bio- degradation process that takes organic wastes. Remains of plants and garden and kitchen waste and turns into nutrient rich food for your plants. Composting, normally used for organic farming, occurs by allowing organic materials to sit in one place for months until microbes decompose it.

According to Haseeb Jamal Jan 19, 2020, Collection of commingled waste and separated waste in an urban area is difficult and complex. The generation of residential and commercial-industrial solid waste takes place in every home, every apartment building and every commercial and industrial facility as well as in the streets, parks and even vacant areas. With the increase in developmental activities throughout the country, the collection system is becoming more and more complex. It is also due to the fact that there are different types of solid wastes which require different collection methods and other subtleties during collection. The need to collect solid waste is important for the health of the citizens, environmental sustainability, beauty of the area, and economic development. Climatic conditions and requirements of a locality as well as containers and costs determine the frequency of collection of solid wastes. In hot and humid climates, for example solid wastes must be collected at least twice a week, as the decomposing solid wastes produce bad odor and leachate. And as residential wastes usually contain food wastes and other rotting material, frequent collection is desirable for health and aesthetic reasons.

According to Andrew Othuke Akpeli (2018), influential leaders or community figures play a crucial role in convincing people about waste management. It is important to identify individuals whom the community trusts and listens to, such as ward chairpersons who are elected members of the ward committee. Their support and involvement in planning and implementing waste management initiatives are essential for effective outcomes. Additionally, elders in the community serve as a valuable resource due to their experience and knowledge gained from previous development processes. Their consent is often necessary for implementing any activities, and they play a significant role in decision-making and providing advice. Furthermore, women have a vital role in waste management, as they are responsible for cleaning the house and disposing of daily domestic waste. Their active participation in activities such as weekly Street cleaning contributes significantly to maintaining a clean community (Akpeli, 2018).

3. **RESEARCH METHODOLOGY**

3.1 The Study Area

The study was conducted in Huruma estate which is located in North of East of Nairobi, The capital of Kenya. It borders Kariobangi and Dandora to the east, Moi air base to the south, Mathare to the north to west and Eastleigh to the southwest.

3.2 Research Design

A cross sectional research design was adopted for this study and it employed a qualitative approach by way of using both open -ended and closed -ended questions in order to ensure more accurate findings and conclusions.

3.3 Sampling Population, Size and Procedure

The population for Huruma estate is approximately 74,589 the number of households 161. A sample size of 44 respondents was randomly selected.

3.4. Data Collection

Random sampling technique was used to distribute both closed and open-ended questionnaires to household heads to collect primary data on the methods used in waste disposal, the frequency and the role of the community in effective waste disposal.

Secondary data was obtained from review of relevant books, journals and publications from various government and non-government organizations to provide relevant information on the area of study to back up data obtained from the household questionnaires.

3.5. Data Analysis

The co quantitative data obtained from the field was entered in SPPS (Statistical Package for Social Science) and various statistical methods of analysis applied to test hypotheses and meet each study objective. To determine the effectiveness of solid waste disposal methods, solid waste disposal were measured in terms of death rates, health effects, human displacement, contamination of water supplies and increased prevalence of diseases.

4.0. RESULTS AND DISCUSSIONS

4.1 Socio-Demographic Information of the Participants

4.1.1 Respondents' age

According to the findings of the study majority of the respondents were aged between 41-50 who added up to 114 and represented by 54.3%, followed by those aged between 31-40 years with 39.5%. Further, those aged between 26-30 years were 3.3% while those between 18-25 years were 2.9%.This gave an implication that respondents at the area were old enough to provide the required information.

4.1.2 Gender Distribution

Gender equality is an important consideration in almost all spheres of any institution. From the study 76.7% of the respondents were found to be male while females were 23.3%. However 0.8% of the respondents declined to indicate their gender. To that end, there was no gender equity implying that these were no adherence to the constitutional provision which stipulates that no gender should exceed a third in a group composition.

4.1.3 Level of Education

Results from the studies indicated that the highest number represented by 47% had TEVs as highest education level. This was distantly followed by 28 6% with secondary and below educational level. On the other hand 1% had post-graduate level of qualification. The interpretation was that majority of the respondents were fairly educated to provide required data that needed relative literacy. Also the 5% and 1% respondents of bachelor's degree and post-graduate level respectively were adequately qualified to provide the strategic and tactical information required. However low education levels work against sustainable development predicted on more knowledge and awareness of waste reduction philosophy and practices only possible with increased education levels.

4.1.4 Household Size.

Size of a household was relevant in the current study due to its role in the generation of solid waste. As such the respondents were asked to provide number of bonafide members of their families. According to the results, out of the 210 respondents who had returned their questionnaires 56.2% had a household between 6-10 members while 2.1% had over 10 family members. The interpretation was that most families were small in size implying that the amount of solid waste generated by most families is minimal. It was a positive trend towards reduction of solid waste towards many global, regional and local sustainable development agenda.

4.2 Methods Used In Solid Waste Disposal

It was also imperative to determine the methods used in solid waste disposal by the residents of Huruma slums because they influenced their significant effects in their locality. According to the results, the method of disposal regularly practiced was discarding along the road heaps/drainage at 48%, followed by burning at

28%, Burrying in the ground and in the bush had the lowest percentage .From the results it was evident that the area is at high risks or are exposed to hazardous effects i.e. spread of diseases.

4.3. Type of wastes released from household.

According to the results, the dominant waste released from household to the environment was food waste, because it had the highest frequency while textile waste was the least with 6%. This was essentially done to identify the type of waste been disposed of in the open dumpsite.

4.5 Frequency of Solid Waste Collection

With respect to the solid waste collection frequency by the existing collection systems 57% of the respondents indicated inconsistency in the collection, 7% once a week, 17% twice a week and 19% three times a week. The highest percentage of collection frequency being inconsistent in the low income residential areas may be attributed to the low priority given to people in low income areas when it comes to issues that concern their welfare. The high and regular collection frequency in the high income residential areas may be due to the high income residential areas may be due to the high premium paid by households relative to the other residential areas.

4.6 Waste Disposal and Management

According to the study, 31.8% of the respondents mentioned that residents managed solid waste collection and disposal by hiring private garbage collectors. However, a significant majority of 68.2% stated that they were not involved in any form of waste management, leading to improper waste disposal practices. Some residents paid for private services, while others took their waste to designated collection points where it was picked up by the county government garbage trucks. The study also identified various disposal options among the residents, with 48.0% discarding waste along roads, drainage channels, and other undesignated areas. About 25.1% stored waste in dustbins and eventually took it to designated collection points. A small percentage of 4.7% preferred storing waste in dustbins and later emptying it into county skips, while 8.8% opted for burning waste. Only 3.5% of the respondents indicated that they recycled some of the waste. Furthermore, the study revealed that a majority of the respondents (85%) were unaware of the health and environmental impacts of improper waste disposal, indicating a lack of public education and awareness on the subject.

4.7 Role of the Community on Proper Solid Waste Disposal.

There is generally a negative attitude towards community participation in solid waste management 45%, they not consider the implication inappropriate disposal on the health of the people, and so the pay little or no attention to how and where are solid waste are disposed while 31%responds with a positive attitude to solid waste management or when a community effort is going on. This implies that to achieve effective community participation in solid waste management, efforts should be channeled at the attitudes of the community especially through vigorous awareness.

5 Conclusions

The study found that residents' lack of concern for proper solid waste management practices has resulted in detrimental effects on the environment. The dissatisfaction with the services provided by private collectors, including delays and irregular collection, has led residents to resort to unorthodox methods of waste disposal. Analysis of the data collected highlights the prominent issue of uncollected solid waste, particularly in low and middle-income neighborhoods within Nairobi's Huruma estate. The study identified various challenges faced by Huruma residents regarding waste disposal and collection systems, including the failure of the county government authority to prioritize waste management guidelines and

legislation, inefficiency in waste collection, and poor infrastructure. Furthermore, there is a lack of coordination among the multiple actors involved in waste management, and in some areas, waste collection systems are nonexistent or plagued by numerous challenges, including residents' inability to pay for services. .

6 Recommendation

Nairobi county government should enforce existing management of solid waste policies and legislations as spelled out in environment management and coordination Act 2019, the Kenyan constitution (2010) and in the Nairobi County solid waste management Act 2015.Nairobi county government should engage other stakeholders in sensitizing residents on sustainable management systems on the solid waste that include separation, reuse and recycling. Nairobi county government should institutionalize management of waste processes by investing me efficiency and infrastructural capacity by providing skips trucks, bins as well as guidelines on modalities to service providers on proper waste management. The findings of the study can be replicated in other urban centers of developing countries. This would help mitigate environmental issues associated with poor waste management systems.

Further research should be done on other solid waste aspects such as the various types and their impact on the environment to enhance a clean and healthy environment

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NUMERICAL SIMULATION TECHNIQUE FOR CHEMICAL CONTAMINATION IN GROUNDWATER

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ABSTRACT

In nature, almost all systems are not static but rather dynamic. It is for this reason that natural systems can be predicted using mathematical models. These models are usually Partial Different Equations (PDEs). Examples include the wave equation, equations for diffusive processes, and the heat conduction equation. A suitable numerical solution of such PDEs for a given process in a given system and its implementation using a suitable computer code can lead to vital predictions on the system's behavior/ nature, both in space and time. The challenge that stands between the formulated PDE and its implementation using a computer code, remains to be its numerical solution. A suitable numerical scheme yields an appropriate algorithm which can be implemented using computer codes. Broadly speaking these schemes are grouped as either; Difference Schemes (DM), Finite Element Methods (FE), Boundary Value Methods (BV) and Finite Volume Methods (FV). The objective of this paper, is to present the Integrated Finite Difference Method (IFDM), as a numerical technique for solving the chemical equation so as to predict its contamination levels in a groundwater formation. The algorithms so generated are implemented using an object oriented code written in C++ language. Generic results generated represent important predications on the fate and transport processes of a chemical in an aquifer. This is important and urgent in ground water pollution and consequently the recommendation that more work on numerical work should be included in our curriculum especially for engineering and computer oriented courses on offer in our Colleges and Universities

Keywords: Simulation, IFDM, Contaminant Equation

1. Introduction

The Natural systems or generally the physical nature, are dynamic e.g. water in a stream, waves on lakes and heat flow. The nature of such dynamism can be predicted using appropriate mathematical models. These models are usually Partial differential equations, PDEs, Capable of predicting behavior of the system in space and over time

Examples include the wave equation, equations for diffusive processes, and the heat conduction equation as given below:

a. General wave equation;

$$\frac{\partial^2 y}{\partial x^2} = \frac{1}{v^2}\frac{\partial^2 y}{\partial t^2} \qquad (1)$$

It couples information about the shape of the wave, and velocity and accelerations of the particles within the medium through which the wave is travelling.

b. 1 – D 2nd Law of heat conduction;

$$\frac{\partial T}{\partial t} = D_T \frac{\partial^2 T}{\partial x^2} \qquad (2)$$

The equation describes the rate of heat flow through soil (non - steady case where the temperature flux at each point varies in time and space.

D_T, is called the thermal diffusivity containing volumetric heat capacity C & thermal conductivity, K. Together, they are called "thermal properties" of soil. The thermal properties can be measured in the field

c. 1-D ground water flow equation (along X- axis)

$$\frac{\partial}{\partial x}\left(K\frac{\partial h}{\partial x}\right)-W=S_s\frac{\partial h}{\partial t}$$

K, W and S_s are field parameters that directly affect the rate of water flow (flow flux)

The 3-D version of this equation takes the form;

$$\frac{\partial}{\partial x}\left(K_{xx}\frac{\partial h}{\partial x}\right)+\frac{\partial}{\partial y}\left(K_{yy}\frac{\partial h}{\partial y}\right)+\frac{\partial}{\partial z}\left(K_{zz}\frac{\partial h}{\partial z}\right)-W=S_s\frac{\partial h}{\partial t}$$

The equation assumes Cartesian flow from a point source proceeding along x-, y-, and z-axis

d. Chemical transport and transformation equation in a groundwater formation/aquifer

$$R\frac{\partial(\theta C)}{\partial t}=\frac{\partial}{\partial x_i}\left(D_{i,j}\frac{\partial C}{\partial x_j}\right)-\frac{\partial}{\partial x_i}(V_iC)+\frac{q_sC_s}{\theta}-\lambda\left(C+\frac{\rho_b\overline{C}}{\theta}\right)$$

The equation presents the following processes as affecting the transport of a chemical; Advection, mechanical dispersion, chemical diffusion, adsorption, Decay, and Sources and sinks

Governing Equations and their numerical Solution Procedure

We note that, a suitable numerical solution of a given PDE for a given process in a given system and its implementation using a suitable computer code can lead to vital predictions on the system's behavior/ nature, both in space and time. To address the challenge that stands between the formulated PDE and its implementation using a computer code, we present a numerical technique that translate the PDE into an algorithm for computer simulation. As an example we have chosen the chemical flow equation

The partial differential equation governing the 3- D transport of a single chemical constituent in an aquifer, considering transport processes, fluid sources and sinks, sorption, and first order irreversible rate reactions is given as follows (Zheng & Bennett,1995) ;

$$R\frac{\partial(\theta C)}{\partial t}=\frac{\partial}{\partial x_i}\left(D_{i,j}\frac{\partial C}{\partial x_j}\right)-\frac{\partial}{\partial x_i}(V_iC)+\frac{q_sC_s}{\theta}-\lambda\left(C+\frac{\rho_b\overline{C}}{\theta}\right)$$

Where C is the dissolved concentration (ML^{-3}); C is the adsorbed concentration (MM^{-1}); t is time (T); D_{ij} is the hydrodynamic dispersion coefficient tensor (L^2T^{-1}); v_i is the pore water velocity (LT^{-1}); q_s is the volumetric flow rate per unit volume of aquifer-representing fluid sources and sinks (T^{-1}); C_s is the concentration of the fluid source or sink flux (ML_{-3}); λ is the reaction rate constant (T^{-1}); R is the retardation factor (L^0); ρ_b is the bulk density of the porous medium (ML^{-3}); x_{ij} is the distance along the respective Cartesian coordinate axis (L); and θ is the porosity (L^0).

For chemicals that do not adsorb, e.g. nitrate, the retardation coefficient is assumed to be. In such case, equation (1) reduces to;

$$\frac{\partial(\theta C)}{\partial t}=\frac{\partial}{\partial x_i}\left(D_{i,j}\frac{\partial C}{\partial x_j}\right)-\frac{\partial}{\partial x_i}(V_iC)+\frac{q_sC_s}{\theta}-\lambda C$$

The 3-D groundwater flow model is solved to obtain the head distribution and subsequently the velocity field for use in equation (2) to account for advection transport of the chemical (Schwartz & Zhang, 2003).

$$\frac{\partial}{\partial x}\left(K_{xx}\frac{\partial h}{\partial x}\right)+\frac{\partial}{\partial y}\left(K_{yy}\frac{\partial h}{\partial y}\right)+\frac{\partial}{\partial z}\left(K_{zz}\frac{\partial h}{\partial z}\right)-W=S_s\frac{\partial h}{\partial t}$$

Where K_{xx}, K_{yy}, K_{zz} are values of hydraulic conductivity along x-, y-, and z- coordinate axes (LT^{-1}); h is the hydraulic head (L), W is a flux term that accounts for pumping, recharge, or other sources and sinks (T^{-1}); S_s is the specific storage (L^{-1}); t is time (T).

2. Discretization procedure

Discretization is the process of breaking the governing equations into discrete components that can be implemented using computer codes; making it possible for an equation to correspond to each cell in the discretised aquifer. This is done because usually reservoirs are heterogeneous i.e., the hydraulic properties vary from point to point within the aquifer. The Partial Differential Equations above are discretised using the IFDM. In this method, nodes are centered in the middle of the blocks and flows are assumed to occur perpendicularly to the boundaries of the blocks. Flows between nodes can then be computed using Darcy's law and the head gradient defined as the difference in heads between neighboring nodes. With this assumption, a system of equations is constructed with one equation for each node. This makes it possible to apply Gauss divergence theorem to the governing equations, converting the integration over block volume to block faces. This method of solution for the model equations is elaborated as follows; Equation (3), when written in indicial form reduces to;

$$\frac{\partial}{\partial x_i}\left(k_{ij}\frac{\partial h}{\partial x_j}\right)-W=S_s\frac{\partial h}{\partial t}$$

Averaging hydraulic properties for each block volume, and integrating over the whole block volume;

$$\int_v \frac{\partial}{\partial x_i}\left(k_{i,j}\frac{\partial h}{\partial x_j}\right)dv-W_v=\int_v S_s\frac{\partial h}{\partial t}dv$$

Applying Gauss's Divergence theorem;

$$\int_s k_{i,j}\frac{\partial h}{\partial x_j}ds_{i,j}-W_v=VS_s\frac{\partial h}{\partial t}$$

Summing over block surface and discretizing in fully explicit form and re-arranging for numerical coding;

$$h_i^{t+1}=h_i^t-\frac{\Delta t}{vS_s}\sum k_{i,j}\frac{\left(h_j^t-h_i^t\right)}{\Delta x_{i,j}}\Delta s_{i,j}-\frac{\Delta t}{vS_s}W_v$$

$$h_i^{t+1}=h_i^t\left(1-\frac{\Delta t}{vS_s}\sum k_{i,j}\frac{\Delta s_{i,j}}{\Delta x_{i,j}}\right)+\frac{\Delta t}{vS_s}\sum k_{i,j}\frac{\Delta s_{i,j}}{\Delta x_{i,j}}h_j^t-\frac{\Delta t}{vS_s}W_v$$

Eqn. 4 represents the final algorithm for the water flow equation

Where h_i^{t+1} and h_i^t are the head value for the next time step and for the present time step respectively for block i, being the block under consideration with its neighboring blocks, j. Considering each block, equation (4) yields a system of algebraic linear equations whose solution results into the field head distribution pattern for the water system under study.

Velocities V_i, are computed from equation (4) using the Darcy equation. Its discretized form is as follows;

$$v_i=\sum k_{i,j}\frac{\left(h_j^t-h_i^t\right)}{\Delta x_{i,j}}$$

A similar approach is followed in discretization of eqn. 2,

Integrating over whole volume, and applying Gauss's divergence theorem;

$$\int_v\frac{\partial C}{\partial t}dv=\int_v\frac{\partial}{\partial x_i}\left(D_{i,j}\frac{\partial C}{\partial x_j}\right)dv-\int_v\frac{\partial}{\partial x_i}\left(V_iC\right)dv+\frac{q_sC_s}{\theta}-\lambda C$$

$$V\frac{\partial C}{\partial t}=\int_s D_{i,j}\frac{\partial C}{\partial x_{i,j}}ds_{i,j}-\int_s V_iCds_{i,j}+\frac{q_sC_s}{\theta}-\lambda C$$

In discretised form;

$$C_i^{t+1} = C_i^t \left(1 - \frac{\Delta t}{v} \sum D_{i,j} \frac{\Delta s_{i,j}}{\Delta x_{i,j}} \right) + \frac{\Delta t}{v} \sum D_{i,j} \frac{\Delta s_{i,j}}{\Delta x_{i,j}} C_j^{\ t} - \frac{\Delta t}{v} \sum V_i C_i ds_{i,j} + \frac{\Delta t}{v} \frac{q_s C_s}{\theta} - \frac{\Delta t}{v} \lambda C_i$$

Equation (6) represents the discretised form of equation (2) which is an algorithm for use in a computer program. It is expressed in the fully explicit form which uses the present parameter values in calculating the new values in the next time step. It is relatively easy to code an algorithm expressed in the explicit form,

Aquifer discretization

For the algorithms to apply to an aquifer domain, the continuous aquifer domain is replaced by a discretised domain, which consists of an array of nodes and associated finite difference blocks or cells (Anderson & Woessner, 1992). A node represents a single point on each cell at which the hydraulic property is averaged or calculated. The size of the node is determined by the extent to which hydraulic properties vary throughout the modeled area

3.0 Results and Discussion

A computer code was written to solve the algorithms obtained over a two layered rectangular grid system. The following generic tests were done and predictions made.

3.1 Hydraulic Head Distribution Levels

The results obtained by the simulator due to pumping and injection tests were in agreement with the laws governing groundwater flow. As expected the characteristic pattern of the head distribution curve during pumping is such that the level first goes down according to the characteristic shape of the transient region and later the piezometric surface no longer changes much; the aquifer goes down uniformly; its evolution at one point is coupled with its evolution at all other points and the drawdown velocity is uniform.

3.2 Effects of Transport Processes and Decay on Chemical Concentration Curves

Tests were done to investigate how each of the transport processes affected the concentration of the chemical at any given time after its instantaneous injection at a point in the aquifer. The modular approach of the object-oriented programming language makes this possible.. the results showed the concentration breakthrough curves for advection transport only. It also showed that the concentration available to the next neighboring point reduces with distance from the injection point, indicating that dilution is taking place. Consequently the concentration level in the source point reduces as the chemical is passed to the neighborhood. The concentration peak value for the dispersion curve was found to be far higher than that of advection, meaning that the chemical takes a long time to reach neighboring horizons and so a longer retention time.

3.3 Porosity Porosity is defined as the ratio of voids to the total volume of a porous media sample. A higher porosity percentage would mean more volume to receive a given concentration of a chemical being injected into a grid cell as opposed to a relatively lower percentage. In a given time interval the concentration will be expected to vary inversely with the porosity value. The Peak arrival time remains nearly the same for all porosity values because once injected into a grid cell, the chemical has to interact with all the water molecules in a given control volume before being passed to neighboring cells. Changing the grid size by a factor of 4, affects the concentration significantly. At higher grid sizes, the concentration peak is far lower than for smaller grid sizes. This is physically expected because the solute is now interacting with more fluid particles than before. In a way, the ratio of the solute particles to fluid particles is increased in case of lower grid sizes.

3 Conclusions

The sensitivity of the model to indicate the effect of various aquifer characteristics on the head and concentration profiles proves the success of the simulation procedure i.e. the solution of the governing equations and their coding. In general the results generated at generic testing using the simulator were physically reasonable and feasible. This means that the simulator can be used in field simulation to predict and monitor chemical behavior once introduced into the aquifer.

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INTEGRATING COASTAL, MARINE BIODIVERSITY AND ECOSYSTEM PROTECTION WITH BLUE ECONOMY AT JUNDA CREEK IN MOMBASA COUNTY.

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ABSTRACT

This paper, seeks to explore integration of community livelihood with biodiversity and ecosystem protection through sustainable livelihood framework (SLH) with blue economy project in JUNDA CREEK Mombasa. Indigenous coastal communities depended on mangroves for centuries, collecting products and resources over the years. Despite benefits of coastal and marine biodiversity today, threats to species ecosystems are increasing with exponential rate which are caused by human mismanagement of biological resources stimulated by economic policies, pollution and faulty institutions in-addition to climate change. Livelihood is sustainable when it can cope with, recover from stress and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base(Chambers&Conway,1991).Sustainable livelihoods framework provides a tool for analyzing people's livelihoods and impact of specific threats or shocks on livelihood vulnerability and does analysis of household assets, strategies, priorities and goals at micro-level, and the policies, institutions and processes that affect livelihoods at national and international level. This study, examines the impact of Coastal marine biodiversity and ecosystem degradation, poor policies and community vulnerability on the sustainability of the blue economy project in JUNDA CREEK. Five questions guided this study. The study is exploratory with a population of 10,000youths' fishermen,700fish vendors in JUNDA CREEK, ministry of fisheries and forestry in the county government of Mombasa.300 fishermen were selected using simple random technique. Open ended questionnaires were administered. Data collected was subjected to descriptive analysis of frequency counts, percentages and mean of influential statistics. The results showed a significant relation between marine ecosystem biodiversity degradation and blue economy sustainability. Therefore, institutions policies, (County government of Mombasa) should integrate community livelihood empowerment activities to support marine/coastal biodiversity and ecosystem protection for sustainability of the project.

Key Words: - Biodiversity and ecosystem protection, Community livelihood, Sustainable livelihood framework, Blue economy

1.0 INTRODUCTION:

In Junda Mangrove, coral reefs and associated ecosystems support high biological diversity that sustains coastal communities. The local communities are often poor and susceptible to social-ecological poverty traps. Seafood consumption is essential to community health through the provision of protein and critical micro-nutrients. However, high seafood production and sustainability is threatened by the ecosystem degradation, poor fishing practices, and climate impacts. Unsustainable behaviors include the common use of destructive fishing gears, such as beach seines such and small-mesh nets. Destruction of habitat and pollution further threaten the productivity that these communities depend on. In addition, the County ambitions of the Blue Economy are growing and placing greater emphasis on marine production and coastal development, which has the potential to further undermine the ability of the vulnerable locals to access and benefit from sustainable fisheries-based livelihoods.

The three small-scale fisheries (SSF) management units existing in Junda creek through Kenya's Beach Management Units (BMUs) have numerous barriers to long-term sustainable management and compliance. These include inadequate capacity of Mangrove, Coral reefs and the associated ecosystem protection skills and lack of sustainable fishing gears information such as biodegradable safety nets and ecological fishing practices suitable for coastal, marine biodiversity protection. Productivity and resilience potentials are often ignored in favour of development agendas that poorly consider actual production and sustainable catch levels. The

participatory nature of the BMUs empowers communities, but they frequently lack management capacity, fair cost-benefits sharing, enforcement mechanisms, and compliance (Sang Chun Kung (2022). Knowledge that contributes coastal, marine ecosystem and biodiversity protection together with the processes needed to reinforce ecological friendly fishery practices, and sustainable fishing gears is lacking. Further, the socioeconomic contexts that enhance adoption biological diversity protection behaviours are rarely taken into consideration. Awareness about effects of climate change and consequences for the resilience and sustainability of SSF is also limited. The research aimed to assess the impact of coastal and marine biodiversity and ecosystem degradation on the Junda blue economy project, examine the influence of existing policies on coastal marine ecosystems and biological diversity protection within the project, investigate how the local community's livelihood is supported by the benefits derived from the blue economy project, and evaluate the relationship between coastal marine ecosystem and biodiversity degradation and the sustainability of community livelihood in Junda creek fisheries.

2. Literature review;

Coastal and marine ecosystems, including blue forests such as mangroves, seagrass beds, and coral reefs, are facing increasing threats due to factors like population growth, pollution, and unsustainable fishing practices (Kang-Chun Cheng, 2021). These ecosystems provide crucial services for human well-being, such as food provision, protection against erosion, and carbon storage. However, the degradation of these ecosystems hinders their ability to deliver these services, impacting local communities' livelihoods and food security. The integration of coastal, marine biodiversity with the blue economy is essential for protecting these ecosystems and supporting sustainable fisheries (Olivier Serrat, 2017).

The Sustainable Livelihood Framework offers a participatory approach to understanding and enhancing livelihood opportunities. It focuses on various livelihood assets, including human, social, natural, physical, and financial capital, to empower the extreme poor and reduce vulnerability (Carney et al., 1999). By applying this framework, interventions can be designed to address the underlying factors that contribute to poverty and vulnerability. Strengthening social capital, empowering human capital, and protecting natural capital through policy development and community ownership are crucial steps in promoting sustainable livelihoods and conservation efforts in Junda creek.

To mitigate the challenges faced by coastal communities and safeguard the blue forests and associated ecosystems, it is necessary for relevant institutions like the County Government of Mombasa, Kenya Forest Services, and fisheries organizations to develop policies that integrate coastal, marine, and biodiversity ecosystem protection with the blue economy project. Such policies would foster community engagement, enhance social capital, and ensure the conservation of natural capital. This integrated approach would help address threats to coastal ecosystems and promote the provision of essential services like shelter and food for fish, benefiting both the environment and local communities. species, which often thrive across mangrove, sea grass and coral reef habitats is one crucial example of the blue forests ecosystems services.

3 Research Methodology

3.1 Research design;

This study adopted exploratory research design to effectively explore the impact of coastal, marine ecosystem and biodiversity degradation on community livelihood sustainability in the blue economy fisheries project in Junda creek. The purpose of this design is to come up with an appropriate research framework and data analysis

methodology, it was justified by the fact that the researcher intended to collect all variables at one time, get a deeper understanding and provide conclusion for each intervention.

2.2 Research nature;

The research used Qualitative and descriptive technique to collect and analyse data to accurately and systematically describe the population, situation phenomenon, Shona McCombes (2019).

2.3 Study Area;

The study adopted qualitative and descriptive approach.The study was conducted at Junda Creek fisheries, Southern Kenya coast, focusing to determine the impact of Coastal, marine biodiversity and ecosystem degradation on the Junda blue economy project,to establish the influence of the existing polices for the Junda blue economy project on costal marine ecosystems and biological diversity protection,to investigate how the local community livelihood is supported through the benefits that accrue from the blue economy project and to assess the relationship between Coastal, marine ecosystem and biodiversity degradation and sustainability of community livelihood in JUNDA CREEK fisheries.

2.4 Target Population

Target population, refers to all the members who meet the criteria specified for a research investigation" (Alvi, 2016). The target population for this study was 300 respondents involving stakeholders in the Junda Creek Blue

2.5 Sampling procedure;

The researcher adopted a formula proposed by Yamane (1969) to obtain the sample size as follows:
The target population was estimated at 300 respondents.

2.6 Data Collection Instrument;

The study adopted primary data. Questionnaire were used as a tool in this study to collect primary data. Five open ended questions were administered in this research to get a deeper information from the respondents on ecosystems and biodiversity protection on the areas of fisheries and how the relevant institutions do support communities' effort on ecosystem and biodiversity protection, (Orodho 2015).

2.7 Data analysis;

Questionnaires were coded for all questions related to each research objective to ensure that data processing can be carried out smoothly. The collected data was analyzed using a qualitative method and analyzed using descriptive statistics. Descriptive analysis involves converting raw data into graphs, tables with a percentage frequency distribution to allow full interpretation of the data (Schindler 2017),Correlation analysis was used to determine the strength of the relationship between study variables. The data was also analyzed using statistical methods and the results are presented in tabular and graphical form. Descriptive statistics refer primarily to the frequency, percentages, and means by which responses are summarized. Multiple regression analysis was used to establish relationships between independent and dependent variables.

Assessment of interviews were limited to human practices, behaviours and interest towards sustainable fisheries, integrating fisheries activities with community livelihood focusing at attaining ecosystem and biodiversity protection and how existing institution do support sustainable fisheries and Coastal, marine ecosystem and biodiversity protection in the three (SSF)at JUNDA CREEK blue economy project.

Random sampling was done to administer the questionnaire where a total of 150 respondents including 5 key informants were interviewed.

To triangulate the results from the individual's surveys, an in depth interview with 5 key actors in the SSF's and other stakeholders who are resourceful persons identified through random sampling technique, (Atkinson and Flint,2001) Data collected included relevant institutions and how they do engage the community members on sustainable fisheries, perceived challenges and structures put in place towards ecosystems and biological diversity protection within the three SSF's.

Qualitative data was reviewed, explore and coded into themes using presented narratives. Quantitative data from the surveys were organized using SPSS software versions 20 and analysed using descriptive statistics and presented using graphs.

3.0 RESULTS AND FINDINGS:

3.1 Community livelihood initiatives;

The study identified three Small scale fisheries in JUNDA CREEK project Mombasa southern Kenya. These SSF's includes Jahazi marine, Boyani and Junda mission at the furthest and opposite Mikindani. Fishing is done in small scale, small mesh nets and canoes that contribute towards overfishing including disruption of biodiversity. Mangrove in the three fisheries were perceived to be degraded.

3.2 Community motivation for ecosystem and biodiversity protection;

The key actors participating in the ecosystem and biodiversity protection in Junda creek are local community groups, Community base organizations and Kenya fisheries and Kenya forests. The local community groups include the registered fishermen, un employed Youths who form the largest population. Kenya fisheries and Kenya forests play a crucial role in ecosystem and biodiversity protection through reinforcing policies on coastal marine ecosystem protection. In addition, several gaps exist on integration of sustainable fisheries in JUNDA CREEK with the community livelihood for sustainable ecosystem and biodiversity protection.

3.3 Community perception towards integration of ecosystem and biodiversity protection with fisheries;

Most respondents 71.2% cited that ecosystem protection as difficult task given the nature of the community vulnerability and the nature of fishing gears, practices and community livelihood activities, unlike 29.8 % who said it is easy. Among the key actors interviewed highlighted inadequate resources(finances), lack of skills, knowledge on sustainable fishing techniques including unavailability of biodegradable safety nets in the market and lack of knowledge on coastal, marine biodiversity and ecosystem monitoring process as the key setbacks that hindered the achievement of the project. Respondent who participated in the community livelihood support in relation to ecosystem and biodiversity protection despite these challenges they perceived that biodiversity protection was motivated by the need for ecosystem and biodiversity stipends (financial compensations), increased fisheries gears and equipment together with community livelihood support.

4.0 DISCUSSION

The sustainable livelihoods framework helps to organize the factors that enhance livelihood opportunities and shows how they relate to one another. The livelihood assets which the poor must often make trade-offs and

choices about, comprise: Human capital, Social capital, Natural capital, Physical capital and financial capital, Olivier Serrat, (2017).

Furthermore, effective integration of the Blue economy with Coastal, marine ecosystem and bio diversity protection fisheries will support **greenhouse gas sequestration**; coastal ecosystems such as salt marshes, sea grass beds and mangroves absorb large amounts of carbon dioxide and contribute to the world's carbon fixation and carbon storage.

However, over the years, population growth and economic development have resulted in an increasing number of human activities on land and an increase in pollution globally which has contributed to degrading the environment and the related ecosystem services. Overall, it is estimated that 80% of the pollution loads in oceans and coastal waters originate from land-based activities.

5.0 RECOMMENDATION

The research recommends for integration of community livelihood activities with coastal, marine ecosystem and biodiversity protection within the three SSFs in Junda creek blue economy project.

However, community livelihood initiated biodiversity and ecosystem protection program needs to be developed in JUNDA CREEK fisheries through empowering the local community and ecosystem protection (stipends)this includes cash for work programs(Care 1999).

In addition, relevant institutions(Kenya forests, Kenya fisheries and the County government together with the National government) needs to empower local community on knowledge ,skill and capacity to deal with coastal, marine ecosystem and biodiversity protection for posterity of blue economy.

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A DESCRIPTIVE ANALYSIS OF ANTHROPOGENIC ACTIVITIES CAUSING LOSS OF SPECIES IN MAU FOREST IN NAKURU COUNTY, KENYA

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ABSTRACT

The Mau forest has significant biological, environmental and sociocultural roles but is threatened with excisions from other land uses and degradation from human encroachment from the surrounding communities which has negatively affected the state of the forest in terms of its distribution, species diversity, abundance, as well as the ecosystem services it provides. This study assessed the impacts of human encroachment on the Mau forest. The following specific objectives guided the study: to find out what type of tree species is under threat as a result of human encroachment as well as its abundance and dominant species, and to find out the various anthropogenic practices that have led to deforestation of parts of the Mau forest. Descriptive survey design, and Field survey design followed by laboratory tests and use of stratified and random sampling techniques were employed to actualize the objectives of the study. Data was collected through; interviewing of conservation stakeholders such as the KFS, KWS, KEFRI, together with the local communities in the encroached areas by use of questionnaires, observations and site visits which were conducted on weekly basis. To assess the specific diversity and distribution change, five quadrants were casted randomly on selected stratas of the forest, and the vegetation cover therein established. Statistical Packages for Social Sciences (SPSS) version 20.1 was utilized to analyze the questionnaire data, and the results were represented by use of charts and tables. The results of the study established that the Mau Complex is highly encroached, with most of the causal human activities being to satisfy the increasing human needs and reliance of forest resources, and a lack of a clear demarcation of the boundaries between the forest and community land. Such has contributed to the gradual encroachment into the forest by the local communities.

Key words: Anthropogenic practices, Mau complex and encroachment.

1.0 INTRODUCTION

Human encroachment results into gaps in the forests or changes in the vegetation characteristics, or a total clearance the ecosystems. It can be detrimental to forest resources, which constitute a critical component of the world's biodiversity as many forests are more diverse than other ecosystems.

Forests cover 31 percent of the global land area. Approximately half the forest area is relatively intact, and more than one-third is primary forest. Deforestation and forest degradation continue to take place at alarming rates, which contribute significantly to the ongoing loss of biodiversity. Since 1990, it is estimated that 420 million hectares of forest have been lost through conversion to other land uses, although the rate of deforestation has decreased over the past three decades.

Mau forest is a very essential resource due to its role in water catchment and it being a home to a variety of biodiversity. It also provides various biodiversity services, hence the need to come up with ways to help in managing the effects of human encroachment.
The local communities living adjacent to the forest, and the indigenous people like the Ogiek who have lived inside the forest for over 100years, are the key beneficiaries if the forest acquires a steady supply of wood, water, clean air and other services such as honey, fruits etc.

Population expansion continues to be the main driver of deforestation and forest degradation and the associated loss of forest biodiversity. Recent studies show that forests in Kenya are becoming vulnerable due to the adverse effects of both natural and anthropogenic activities such as agriculture, settlement, charcoal burning etc. In this case Mau forest, which is in rank as number one in biodiversity richness, and also a water catchment area, is under the threat of human encroachment. The forest covers over 400,000 hectares, hence a key biodiversity resource for the nation.

Mau forest has undergone excisions over the last few years due to human encroachment which is an indirect cause of human population growth. Activities like farming, settlement, hunting and gathering etc has led to degradation of forest vegetation and loss of some species. There is reduction of river flows which has led to reduction in production of HEP. Loss of vegetation has resulted to loss of wildlife habitat and reduction in pastoralists' livelihoods downstream. Further degradation will alter the roles of the forest including its biological richness which has not been fully documented. The reduction in forest roles will further aggravate the livelihoods of those who depending on it. If human encroachment and vegetation degradation is not halted, the roles of Mau forest as a catchment area and habitat will be lost. Therefore, the Mau forest should be constantly assessed of any possible changes in its species richness and integrity. This study assessed the anthropogenic activities leading to species loss and determined the type of tree species that is under the most threat from the activities. The results of this study greatly informed the government and non-governmental institutions concerned with the management and conservation for the necessary actions to salvage species loss and protect the Mau forest ecosystem.

2.0 LITERATURE REVIEW

Human encroachment is any human induced activity in the forest that is detrimental to the survival of a forest. It may results into gaps in the forest or changes in vegetation characteristics, or a total clearance of the forest. Natural ecosystem stability; its resilience is a function of biotic and abiotic environmental component often in a complex interaction (Hugget 2004). Forest ecosystem faces real-time influence from anthropogenic activities beside climatic challenges. Human activities affect forest ecosystem both directly and indirectly through interaction in the process of resource exploitation. Sensitive is the magnitude for exploitation driven by demands for living space, food, shelter, grazing field, and farmland among others.

Modern day humans transform a landscape and reduce the original habitat to a small fraction of its former area (habitat fragmentation) (Lomolino and Brown, 2006). This conjures up an image of circumscribed island of natural habitat jutting from an advancing sea of agriculture or other form of land development, isolated habitat remnants and nature reserves assumes implicitly and explicitly that these are configured islands. One of the most fundamental characteristic of vegetation is its susceptibility to change (Teller, 1992). The concept of vegetation change and stability in composition and structure of any plant community also reflects the interaction between its components and their habitat through time (Hugget, 2004; Ogutu, 1991). Meffe and Carrol (1997) assert that successful conservation requires knowing what the patches are, how they change, and how they are affected by fluxes from outside the targeted area. There may be important fluxes such as immigration of both

the flora and fauna species that have been halted or reversed by human activities over a longer period of time on the landscape.

There are measures that have been put up to ensure that the forests are conserved as in (Hambler, 2004) stating that conservation policy needs to be developed in the light of public opinion, which can indicate the social benefits of the policy. Often these conflicting policies have been promulgated and justified on economic grounds resulting in trade-offs between environmental and economic goals concludes Ludeki et al (2006).
Forest encroachment goes hand in hand with degradation which is the decline in the quality of a forest. As in the case of Mau Forest Complex, the degradation is already felt in forms of uncontrolled floods in the lower courses of the rivers originating from the forest and droughts in the arid and semi-arid areas (Kirubi et al., 2000). Laura (2003) stated that the clearance of forests and fires accounted for the loss of about 16million hectares of forests in the world every year which in turn results to reduction of biodiversity, and susceptibility of land to droughts and floods. Laura (2003) further explains that 22% of the earth's original forests that remained intact are found in areas that can't be assessed my man easily.

Human activities directly or indirectly influence vegetation characteristics at a point. Direct human activities include but are not limited to total clearing, cultivation, selective cutting and burning. Indirect activities includes livestock grazing and browsing, habitat modification, and pollution among others (Ward, 2009; Hugget, 2004) and Graham, 2002). It is also evident that as the population grows in a country the demand of land for agricultural activities and settlement also increases. This is partly because agriculture is the backbone of Kenya's economy and the bulk of the rural population have an extractive economic base dependent mainly on land.

3.0 MATERIALS AND METHODS

3.1. Study Area

3.1.1 Location and Description

The Mau forest complex is located about 170km North-West of Nairobi covering about 400000 hectares of land. The Mau is the largest biodiversity sanctuary in East Africa and it lies across the Equator between 00 1' 0" N and 00 55' 0" S and between the latitudes of 350 15' 0" and 360 15' 0" E. The Mau forest complex is the largest water catchment area in Kenya and is an essential source of key rivers such as the Nzoia, Yala, Nyando, Sondu, Mara, Ewaso Nyiro (south), Naishi, Makalia, Nderit, Njoro, Molo and Kerio. The people dominating the surrounding areas of Mau forest are the indigenous Ogiek communities.

3.1.2 Study area Map

3.1.3 Vegetation

The Mau Forests Complex comprises a diversity of forest types and is a host to many indigenous plant species. Although the vegetation pattern is complex, there is a broad altitudinal zonation from west to the east: lower montane forest below 2,300 metres; mixed Bamboo /forest / grassland vegetation above 2,300 metres; and finally higher altitude Juniperus -Podocarpus - Olea forest near the top of the Mau Escarpment.

3.1.4 Climate and soils

The climate ranges from cold to hot and humid weather conditions. There are also arid and semi-arid conditions in the lower parts of the Mau catchment area. The mean annual rainfall averages 750 mm, falling within the periods of November to December and April to May. The total annual rainfall increases and becomes more certain and dependable with increasing altitude. The temperatures range from 160'C to 22'C with July being the coldest month. The potential evapotranspiration is at 1400 to 1800 mm per annum. The soils are mainly mollic andosols derived from tertiary volcanic parent material. There are also inclusions of cambisols on steep slopes

and humic nitosols in poorly drained sites (Somroek et al., 1980). In general, the soils are well drained, fine textured and of high agricultural potential (G.O.K1997).

3.2 Research design

The study adopted descriptive research design coupled with field survey for collection of both primary and secondary data on the antropogenic activities causing species loss and trees species that are under immense threat from the activities.

3.4 Sampling Technique

Random sampling technique was used to collect samples. The sample population of 90 was chosen. Purposive sampling was utilized, to identify resourceful persons with knowledge concerning the research topic at hand. Such included KFS, KWS, KEFRI, and other personnel.

3.5 Data collection

The study relied on both primary and secondary data

3.5.1 Primary data

The sources of primary data included questionnaires, interviews, observations and use of maps.

3.6 Identification of species distribution and abundance

The study area was sub-divided into five stratas from which quadrats of 100m by 100m was used to collect data for establishing species diversity and evenness. The tree species present in each strata was summarized and their richness and evenness recorded. Simpson's Diversity Index was calculated using the presented data, and used to establish diversity. The results of the Simpson analysis were then used to calculate diversity, and establish if the forest was experiencing encroachment effects and threats. The formula below was used to calculate the Simpson's Diversity Index (D).

3.7 Data Analysis

The data collected was processed and analyzed by the use of the Microsoft Excel and the Statistical Packages for Social Sciences (SPSS) tools in order to describe and summarize it, identify the relationship and differences between variables and the differences and the forest outcomes.

3.8 Data presentation

The analyzed data was presented in the form of pie charts, bar charts and tables for easy interpretation of the variables.

4.0 RESULTS AND DISCUSSION

4.1 Questionnaires Response rate

89 out of 90 questionnaires were correctly filled, giving a response rate of 96% as shown in table 4.1 above. According to Mugenda (2003) a response rate of above 70% is usually considered appropriate for the data analysis.

4.2 Background information

The background information was important in understanding the respondents and significant in their interpretations. The respondent's background information significant to this study included age, level of education, occupation, and length of stay in the study area.

4.2.1 Age distribution of the Respondents

The age distribution of the respondents was in the following proportions: (35.8%) 39 and 48 years, (15%) ranging in at 18-28 years, (32%) aged between 29 and 38 and 9 (16.9%) aged above 49 years. Based on the data, the various age groups in the populations were fairly represented.

4.2.2 Education level of the Respondents

The majority of the Respondents 39.6% had secondary education, 20.7% had primary education, 18.8% had tertiary education, 15.1% had University education and 5.6% had not attended any school as it is illustrated in

4.2.3 Occupation

It was important to assess the occupation/ positions of the respondents in order to gauge how dependent they were on the forest and if they had alternative sources of livelihood. Most of the respondents 47.1% were farmers, 30.1% were business persons, 15% were employed and 9.4% were not employed.

4.3 Human forest uses affecting species diversity and abundance.

The respondents were asked whether they use forest resources or not. The researcher wanted to find out the benefits they derive from the forest. All the respondents in the study area responded that they use the forest resources. 5.6% said they use the forest for worship, 35.8% said they cultivate in the forest to satisfy their food requirements, 16.9% said they obtain firewood from the forest, 11.3% said they obtain building materials from the forest, 9.4% said they obtain herbal medicine from the forest while 20.7% of the respondents obtain charcoal from the forest. Such uses directly and indirectly cause change in the species distribution and abundance as the human beings continue to over utilize the forest resources. Some of the tree species like Teclea nobilis is facing a big threat as it is best in producing quality charcoal which makes the forest users to over utilize the tree species and this if not properly managed it will threatened its existence in the forest. It has been noted that majority of the community members wants to access the forest land for agricultural practices and this leads to clearing of the forest. Proper management should be put in place to aid in controlling farming in the forest so as not to affect the tree species together with the fauna species in the forest.

4.4 Tree species under threat from human encroachment and their abundance and dominance

According to the results obtained and as shown by the diversity index in figure 4.5 above, the South Western block of Mau forest is recovering slowly after encroachment experienced in the past years and as a result of actions of restoration taken by the government to conserve the forest although there is still some degradation. Then First quadrant shows that there is some degradation because there is least number of tree species found in this quadrant.

Teclea nobilis is the least in terms of abundance as the number recorded in all the quadrants is the least compared to the other tree species found in all the quadrants. This might have resulted due to the fact that the locals used it so much in burning charcoal for economic purposes and this has threatened the existence of this species in South Western Mau.

Cussonia spicata is the most abundant tree species in the forest as it records the highest number of individuals in every quadrant, this may indicate that the locals does not use so much this kind of tree species

The other tree species are moderately utilized in the forest because it records slightly higher number of individual species per quadrant for example **Celtis africana** and **Pavetta abyssinica** but there are some species which recorded slightly smaller number of individual species per quadrant for example **Celtis africana** and **Maesa lanceolata** which indicates that the local community and the factories maybe utilizing this kind of tree species in large numbers, actions should be taken to ensure sustainability in the use of the forest resources and to avoid more degradation.

5.0 **Conclusions**

From the results obtained, it is evident that Mau forest has been greatly encroached, the intensity is especially greater in South Western Mau where there is various companies' anthropogenic activities. This could be attributed to no clear boundaries separating the Forest reserve from the community land. This has made the people in the area to move freely slowly by slowly carrying out various activities. The other possible reason is that the local communities are experiencing land shortage to carry out activities like farming and settlement especially with an increasing population.

Poverty is one of the main reasons which was concluded to be encouraging Mau forest encroachments from the local communities who exploit the forest resources to supplement their unending needs. To curb the seemingly impending disaster, the local communities should be made aware and trained on measures that should be taken to conserve the forest, and strategies to utilize the resources sustainably.

The government through the KWS should make an effort to involve the local communities in setting up income generating activities such as bee keeping and other activities that can be undertaken while conserving the forest resources, and which pose little to no threat on the forest resources.

It has been noted that the encroachment of Mau forest by the local communities renders some of the tree species vulnerable to degradation and extinction especially the indigenous species. Some of the tree species identified like Teclea nobilis and are much threatened as the local communities uses them to burn charcoal as it is believed to produce high quality charcoal, also tree species like Celtis africana and Maesa lanceolata which whose abundance in most parts of the forest show that it is affected by encroachment as it may be preferable species for specific purposes.

The study assessed human activities affecting the forest's viability. The communities living near the forest were asked to state which resources they derive from the forest.

The study established that most of the local communities are engaging in farming with an aim of increasing their agricultural production. The local communities have found themselves clearing the forest so as to find more space for cultivation and this has threatened the viability of the forest.

Another activity identified as a big threat to Mau forest is charcoal burning which is practiced by most of the local communities for economic purposes.

There are some other human activities like fetching firewood, acquiring building materials, herbal plants extraction, etc., which also have gradually been affecting the sustainability of the forest.

6.0 Recommendations

From the study the following policy and research recommendations were made:

The government through the Ministry of Lands and the Ministry of Environment and Natural Resources should take action and draw the boundaries in order to separate the forest land and the community land. This will help to reduce the instances where the people are found to have encroached the forest. Moreover it should fence the forest and create a main entrance to control the movement in and out of the forest

The local communities should be informed and empowered on other sources of power and fuel like use of the natural gas, use of electricity and petroleum products so that the Utilization of firewood and charcoal from the forest will reduce hence conserving the forest. In addition, forest department through its officers to regulate the use of forest products through partial closure to allow micro- ecosystems to stabilize and succession species to grow to maturity

Since the local community is willing to take part in forest conservation, the public should be educated on the need to conserve the forest for both consumptive and non- consumptive benefits, diversify conservation programs and involve them through the present administrative structures and social formations like Community Forest Associations.

The study recommends enforcement of regulations on cutting and collection of firewood and farming activities in the forest by the forest department and all the stakeholders. Develop and stick on annual allowable cut on firewood collection. The forest Act (2005) does not allow browsers, and its implementation has failed in Mau Forest. Imposition of strict penalties should put in place to safeguard the vegetation integrity.
Further research should be done on Ways of involving the public in Forest conservation through participatory forest management for sustainable forest use and on restoration opportunities for degraded forests.

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HARNESSING CHEAP SOLAR ENERGY BY USE OF PLASTIC TO SUPPLY ELECTRICITY FOR ONLINE LEARNING

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ABSTRACT

Semiconductors can be made from solar to provide cheaper solar panels for harnessing energy, which will help those from middle and low-class countries afford solar panels. The cheap solar panels will enable students and many parents to afford them, which will help them learn online, which has been perpetuated by covid-19. Solar made from plastics last longer and is cheaper than those panels made from silicon crystals. Solar panels may be installed at focal points in the county to generate large-scale power used for online and blended learning to help build a resilient education system. Polymers are used to make plastics that have very long molecules scientifically proven to be very long. Printing plastic solar cells will require a particular printer that will use plastic ink. The plastic ink is made of two polymers dissolved in a solution. The liquid will dry after printing, enabling the two polymers to form a thin film that can convert sunlight into electricity. Solar is a non-renewable source that shall reduce carbon footprints that may result from other energy sources. The innovation is vital as it will provide an affordable supply of power to all students of either gender to access digital content and online tutorials without polluting the environment. The innovation upholds educational resilience because the energy source will always be constant so long as there is sunshine or light to charge the solar batteries, unlike other sources of energy that are prone to power outages.

Keywords: Solar panels, Plastics, Online learning, and harnessing solar energy.

1.0 INTRODUCTION

1.1 BACKGROUND INFORMATION

In the last two years since Covid 19 struck, all TVET institutions in Kenya adopted online learning. There is a rising and promising future under innovation where integrations are done towards online technologies for formal schooling, especially in TVET. Online learning is never going away, and the country is fortunate enough to have experienced online learning just before its implementation is made possible, as documented in Vision 2030. Online learning has caused the electricity demand to go up, and the country is fortunate enough to use renewable methods to harness electricity. The renewable means of harnessing electricity include waves, tides, wind, solar and geothermal heat (Krebs, Espinosa, Hösel, Søndergaard, Jørgensen, 2013). Having electricity generated for consumption through minimum or no gasoline with very low costs is the best trade-off for online learning. The increasing demand for electricity for learning purposes can be addressed through solar as an energy source. In Kenya today, the solar energy from sunlight strikes our land in two hours more than energy from fossil fuel provided in a year. For daylight to provide electricity for human use, it must be converted into electricity for its practicality since it is universal energy. Solar cells harness solar power for conversion, and silicon has been the most common material to make an active part of most solar cells.

Solar has increasingly been used to supply electricity for both domestic and industrial uses. By extension, solar was used during online learning during the Covid 19 pandemic because there was a lockdown and the Institutions were shut.

1.2 STATEMENT OF THE PROBLEM

Online learning student leads to an increase in demand for electricity, given that students from vulnerable families cannot afford to purchase electricity from the national grid. The learning ways are online learning and blended learning, making it necessary for both trainees and trainers to access electricity and energy all the time and cheaply. During the covid 19 pandemic, most students could not afford power to use in their laptops or phones, making it necessary to develop an alternative way of getting electricity at lower prices. Alternative solar cells have been researched to substitute silicon solar cells because of their cost. An alternative solar cell to be used for making solar panels is plastics. Plastics are readily available and cheap, making them more flexible than silicon. Plastics can be used for light to electricity conversion by printing them on surfaces. They can be printed on any surface ranging from walls to rooftops.

Making solar cells from plastics is very difficult. They are insulators because they do not possess free electrons to help generate and transfer electric current. Dr. Alan Heeger's research discovered a plastic with high conductivity in 1977 (U.S. Energy Information Administration, 2015). The plastic material referred to as conductive polymers make the plastics have free electrons, just like silicon. This property makes it necessary for plastics to make solar cells to harness power energy for various uses, including online learning and blended learning. This study aims to justify that plastic cells can be used to harness cheap electricity for online and blended learning. Plastic cells are flexible to provide power energy.

2.0 LITERATURE REVIEW

2.1 Converting Light into electricity

Solar energy is harnessed using solar cells, which are materials made to convert sunlight into electricity. When the sun falls on a solar cell, the light energy is transferred into electrons, tiny subatomic particles in the material (Peet, Senatore, Heeger & Bazan, 2009). The most commonly used solar cell is made from a semiconductor called silicon, which absorbs light. It is capable of absorbing two-thirds of the solar spectrum. A solar spectrum comprises all visible light, infrared, and UV light. Solar cells made from silicon are about 20-40% efficient in converting light energy into electricity. The main disadvantage of using silicon for a solar cell is that it is costly, which makes the price of a solar panel high. The high cost of installing solar panels is the main reason solar has not entirely been adopted as a mainstream source of energy, especially for learning purposes.

2.2 Conventional silicon solar cells

Solar cells exist in the market and are widely used by most industries and people. Solar cells are generally manufactured from silicone, a material readily available across the earth's surface. The reason for using silicon is that it offers maximum solution due to its ability to have the best carrier mobility than other materials. Silicon-based mobility is the best semiconductor to give maximum output considering photovoltaic uses.

2.3 Construction of silicon solar cells

About 10cm by 10cm of the surface area of silicon solar cells is used to tap solar energy to be converted to electricity. The solar cell structure consists of a thin glass or transparent plastic coating to offer mechanical protection to the solar cell. The construction of solar cells ranges from single crystals to multiple crystals. The solar cells are categorized as Mono-crystalline and Poly-crystalline solar cells.

Every small solar cell can produce about 2 watts of electrical power between 15-20% of the light that strikes the solar cell's surface. Series connections are made to the solar cells to obtain higher voltage or parallel connections for higher current. The links of solar cells result in the formulation of solar panels.

36 interconnected solar cells make solar cells and are eventually laminated using plastic or glass and surrounded with an aluminum frame to make a solar panel. When a person or institution requires more power, more than one solar panel is connected. Every solar panel has a socket connected at its back which is used to make the final connections of the many panels to achieve the required power output. Many solar panels connected are referred to as solar arrays.

A photovoltaic system is classified into two, namely, a Grid-connected system and a Stand-Alone system. A stand-alone system is a PV system connected with the needed load or application. The backing up of the system is backed up using a battery set providing current in case the solar panel fails to provide current. The stand-alone systems are installed and connected in remote locations because making them be linked in the centralized station is very costly.

A grid-connected is the connection of many solar arrays which make power for public use. The grid-connected system can either be unidirectional or bidirectional. The unidirectional grid system is made to supply power during the sunshine period that is mid-day peak, while bidirectional is where the excess power produced is taken back to the grid to be used in the future. The grid-connected system can eliminate the usage of storage batteries effectively.

3.0 METHODOLOGY

3.1 Plastic solar cells

The plastic solar cells, which are flexible, are made from polymers together with inorganic compounds as blends or as composites. This novel plastic solar cell is printed using nanotechnology, which works towards quantum confinement. Quantum confinement is seen when the particle size is too small compared to the wavelength, reducing the Nano-scale level, which makes the confining dimension also small. The quantum confinement makes the energy state increase, and also, the band gap makes both electrical and light properties of the plastic materials change to a large extent. These effects make the plastic solar cells have increased strength, flexibility, and efficiency.

3.2 Printing plastic Solar cells

Solar panels are currently made through printing which is the current technology used. Plastic solar cells are caused by special printers capable of printing materials made from plastics. Plastics have polymers that are very long molecules. Printing plastics requires plastic ink, which contains two polymers mixed in a liquid. During printing, the liquid content in the ink dries up, making the two polymers generate a thin film (Peet et al.,2007). Using pure plastics have an efficiency lower than silicon solar cells. Plastic cells' efficiency is at 1.5% of energy concerted into electricity from solar against the 15-20% efficiency of silicon cells. Research has proven that addicts are a special additive to plastic ink before printing to improve efficiency. The additive is a liquid compound that makes the plastic liquid dry after a longer duration, making no droplets be formed, increasing the efficiency of plastic cells to 12%.

3.3 Changing light into electricity by use of plastic cells

Plastic solar cells contain a plastic layer of glass or a flexible foil. Glass plates are made in the laboratory to have electric contacts that are transparent to form positive (+) poles. Ink is then poured on top of this positive contact to formulate an active layer which is the main component that converts light energy to electricity. The

ink contains double polymers, including a short red polymer and a long green one. The mixed layer of the polymers is shown in the diagram below. On top of the ink, the layer acts as a negative (-) pole. The stuck layers are then placed to put the glass layer to face the sunlight because it is the active part of the cell.

Light at the interface between the polymers creates positive and negative charges. The negative pole of the solar cell will contain negative charges, while the positive pole of the cell will contain positive charges. The poles will produce electricity just as in batteries, and they are powered by the sun.

The diagram shows that the red and green polymers have contact measures. The interface is necessary because this is where the electric charges are initiated. During absorption of light into the structure, the point where there is a yellow star will generate both positive and negative charges. In typical scenarios, positive and negative charges always get attracted to one another, which makes energy or electricity to be lost. But considering the plastic cells, the charges are separated by the red and green polymers making the positive and negative charges move to positive and negative poles, respectively. Eventually, light is converted into electricity in the form of moving charges.

The mixing problem of polymers has been experienced in forming plastic solar cells. To avoid mixing, a boundary should be put between the polymers so that they operate independently. The bottom part of the plastic solar cell is piled with a polymer that has the capability of absorbing ultraviolet light and infrared, and the top layer of the plastic solar cells is filled with a polymer that has the capability of attracting both blue and green light in abundance (Yosoff et al., 2015). The separation between the two layers is done through titanium oxide. This titanium oxide layer puts the bottom cell intact and gives support to the upper plastic solar cell. Titanium oxide has also has the property to conduct electricity just like metals, making the cell have higher collection abilities and transmit the energy attracted by the cell to the load for their application.

3.4 Design and modeling of plastic solar cells

A solar cell is made to possess a current source, and the produced current is channeled to the terminals of the solar for use. At the output terminals, a diode is connected, and the I-V characteristic is analyzed of the plastic solar cells. The figure below represents an equivalent circuit of the cell associated with a diode.

This section focuses on the criteria of generating current within a plastic cell having a multi-layered structure. A flow chart is used for best understanding, as shown in the figure below. There must be a charge controller, an input boost controller that provides enough output considering that the input intensity can also be small. The plastic solar cell is stacked with several polymer layers to increase its efficiency.

The interleaved layers of polymers are put in plastic ink in a 3-D printer based on the digital Light processing technique, which makes the plastic layers a small compacted layer. The top metal surface of the plastic solar cell is coated with zinc oxide, which helps make the cell not to be soluble in water and makes its performance also improve whether the weather is rainy or cloudy. All the structure of the solar cell is enclosed by using indium-tin-oxide that helps in the provision of flexible products and makes the plastic solar module lightweight.

4.0 RESULTS

Since plastic solar cells are cheap to produce on flexible fouls males, it has enormous potential in the education sector to be used for both online and blended learning because of the national grid's instability and unaffordability by those students from vulnerable families.

The plastic solar cell is a vital panel poster because it does not rely on silicon which is very expensive to acquire and fabricate. The plastic solar cells are designed to have a thin structure that can be used as disposable solar by putting and piling several thin plastic solar cells together (Padinger, Rittberger & Sariciftci, 2003). The latter can also be sprayed on any surface to offer a moving energy supply unit. Plastic solar cells do not expose their users to hazards. This property of the solar cell makes it necessary for institutions and individuals to adopt the plastic solar cell because it also assures the users of safety.

Plastic solar cells are more vital, and flexible, and stay for longer than other solar cells, making m more superior in remote areas where the national grid has not reached.

Coating plastic solar cells with polymer makes the cells robust and almost unbreakable, making them necessary in heavy-load applications. The heavy load application can help students taking Electrical use the cells for practicals with the guidance of their trainers during blended learning. The coating makes the cell structure rugged and can withstand rainy and cloudy weather than the solar cells made from silicon. The folding of polymers is controlled by adding a special additive increasing the interface between the red and green polymers, which increases the conversion of light energy to electricity.

5.0 CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

Plastic solar cells are the best alternative to use against fossil fuels because of the existence of solar energy in abundance, and it can be harnessed maximally by the use of polymers. Many people will use these cells for online and blended learning in both households and industries because their costs are low. The plastic solar cells can be used anywhere because they are flexible and have much freedom making it possible for the trainers to take their classes whenever they go away from their institutions or homes. Increased conversion efficiency is achieved through effective structure and design. In the future of the world, plastic solar cells will be the primary energy source.

Plastic solar cells also have the advantage that it does not produce carbon emissions that might harm the environment. This reason makes it very useful to be used on a large scale in its online and blended learning institutions. Plastic solar cells are, therefore, very effective for online learning and blended learning because electricity can be harnessed through them in large quantities and stored where the excess can be taken to the national grid to supply both households and institutions for learning and training purposes.

5.2 RECOMMENDATION

The following are the recommendations for the research topic

I. Research on improving the efficiency of plastic solar cells should be done to make their conversion from 30% to 40%. Complex processing of polymers needs to be discovered to make plastic cells more efficient.

II. Overcoming the challenges of storage facilities that take a long when the weathers change from sunny to rainy or cloudy are produced by solar cells.

III. There is also a need to do much research on the additive added to the polymers to increase the high interaction between the two polymers. New materials for additives should be arrived at and new processing methods achieved.

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ECONOMIC SUSTAINABILITY

FLOATING FARM OPPORTUNITIES AND IMPLICATIONS; ASSESSMENT OF NYANDO TOPOGRAPHY, KISUMU COUNTY.

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A B S T R A C T

Integrated climatic change adoption is essential for agricultural sustainability, especially with the current extreme whether occurrences posed by the global warming. Recurrent flooding has negative effects on agriculture as farmers encounter land, crops and animal losses post every rainy season, a consequence of unpredictable weather pattern. The objective of this paper was to carry out a desk review of Nyando topography in relations to floods, examine farmers' opinion on exploration of waterlogged farms for floating gardening and to determine socio-demographic characteristics of farmers in Nyando wetlands. Descriptive research survey design approach was employed. A structured questionnaire was used for both quantitative and qualitative data which were collected from the beginning of January to end of March 2023 in attempt to answer the study objectives. Purposive sampling was conducted to select one hundred and forty farmers as the study participants. Statistical Packages for Social Sciences was used to analyze the quantitative and qualitative data. The results showed that 83% of the farmers maintained moderately to less favorable opinion towards utilization of the waterlogged wetlands for agriculture as a means of adopting to recurrent floods. Also, Nyando topography review demonstrated suitability for floating farm technique application. The county extensive agricultural office department was therefore recommended to promote awareness creation in their extensive services on climate smart agriculture such as floating farms within the flooding zones. In conclusion, the land gradient, water channels and type of soil of Nyando sub-county makes integrated hydroponics a suitable farming venture for socio-economic and ecological benefits, hence, economic resilience and sustainability amidst dynamic climatic changes.

Key Words: Floating farm; Topography; Climatic change; Extreme flooding

1.0 Introduction

Kenya wetlands occupy about 3% to 4% of the total landmass which is approximately 14,000 km^2 of the land surface and increases up to 6% in the rainy seasons (wetland policy in Kenya, 2008). Nyando specifically, is a region highly vulnerable to adverse effects of climatic change (kinyangi, 2015) and perennial flooding is one of the most disruptive phenomena experienced in the region. Using processed multi-temporal land set images to determine historical changes of land covers in Nyando (PM KUNDU, 2011) predicted a 10% increase in flooding volumes over the years of the study .Also , through the use of a simple hydrologic model integrated with a geospatial data base (Gaya, 2012) indicated a variation in the stream level significant to flooding occurrence observed in every rainy season in Nyando demonstrating effects of climatic changes on flooding and future vulnerability.

Nyando is a flood prone region because of its geographic location. Nyando basin stretches from the Nandi hills to the East all the way to Lake Victoria. The upper part of the Nyando river basin lie between 1800 and 3000 meters above sea level. The River Nyando basin covers three administrative sub counties namely; Muhoroni, Kisumu East and Nyando. In the lower parts of Nyando Basin we find Kano Plains, the area is called Kano Plains because of the flatness of the land. Given the nature of its topography, Kano plains are often affected by floods twice a year contributing to a huge chunk of wetlands. Wetlands are defined as those ecosystems integrating the characteristics of both aquatic and terrestrial environments particularly water, soil and vegetation (Lathrop, 2011). Wetlands in the Nyando River Basin can be grouped as Lacustrine Wetlands (lake like), Riverine Wetlands (those associated with the rivers and streams), Palustrine Wetlands (swamps), a combination of Riverine/Palustrine Wetlands and Manmade Wetlands (created by man) (Raburu, 2012). Nyando is one of the deltaic fringing wetlands on the shores of Lake Victoria and the extremely heavy soils combined with a warm climate, relatively low rainfall and repeated flooding make farming to be unattractive as an economic venture.

Apparently, the long-term waterlogging makes it too difficult for the famers to continue normal land base agricultural activities. Furthermore, the farming communities that solely depend on the land-based agriculture to sustain their lives and livelihoods are severely affected from waterlogged conditions. Problems such as hunger, malnutrition, depression, disease,

unemployment, and social conflicts become apparent and eventually result in economic and social instability (Chaudhari, 2017).Floods are a recurrent problem in Nyando basin and an estimated 5000 people are affected by the flood in the area (KFMS, 2016) .Kenya's record of disasters indicates the worst floods with recent ones considered the most intense, most widespread and most severe. During last season, the flooding was associated with the EL NINO; a disruption of the ocean-atmospheric system in the tropical pacific having important consequences for whether around the globe (UNDP, 2020) . Therefore, it is evident that flooding and waterlogging is a greater threat, not only to the agricultural sector but also to the overall economic, social, and environmental development of Nyando necessitating climate-smart technology on agriculture.

Climate smart agriculture is an approach for transforming and reorienting agricultural systems to support realities of the new climatic change by increasing the adaptive capacities of farmers (Lipper, 2014) in this case the application of hydroponics as a self-innovative floating agriculture. Floating farms, also known as 'hydroponics,' which is a method of growing plants without soil by using inert growing medium, such as gravel, sand, perlite, vermiculite, clay pebbles, etc., where plants receive essential nutrients for their growth either from a nutrient solution or organic materials added to the medium (Johns, 2016) is essential for adaptive actions for the Nyando basin farmers.

Based on a systematic and in-depth review of the published literature, in this study, an overview of the available knowledge relating to floating agriculture practices continentally is presented. With this overview, we then examined the possibilities of indigenous floating agriculture as a technique for climate change adaptation and sustainable economic development in Nyando as per the findings of desktop reviews of Nyando topography. In addition, we attempt to determine the socio-demographic characteristics of farmers within the Nyando basin households in order to identify the knowledge gaps to highlight the requirements for future research so that this practice can be considered a sustainable adaptation to flooding and long-term waterlogged conditions in Nyando.

2.0 Research Methodology

The desktop review was used to analyze the topography of Nyando. An extensive internet search using the most relevant search engines including Google scholar, SCOPUS, AGRIS and Academic Research was employed. The criteria for collecting secondary data included:

a)	**Keywords**	**Floating farm, hydroponics, nyando topography, wetlands, waterlogging, Nyando flooding**
b)	**Region**	Only publications, reports, and articles about Africa were selected for synthesis
c)	**Year of Publications**	The search was limited to publications from the year 2010 to 2022
d)	**Validity of the search**	Only reports from government agencies, UN reports, AU reports, UNDP reports, published research papers, conference papers, and concept papers were selected

A descriptive survey research design through application of structured questionnaire was used as the instrument of the current research. The respondents of the study were purposively sampled observing the following criteria: 1) must be a farmer; 2) must be doing plant farming for more than five years; 3) willing to respond to the questionnaires; 4) a resident of Nyando owning a farm within the wetlands. The total number of farmers whose lands waterlogged after flooding were 385 who then were the population of the study. Among the population, a total number of 140 farmers were selected as the sample utilizing the Equation 1 developed by (Kothari, 2004)and followed by (Portia, 2018)

$$n = \frac{z^2.\sigma^2.N}{e^2(N-1)+Z^2.\sigma^2}$$

Where, n is the sample size, z is the value of the standard variety at a given confidence level. In the present study it was considered standard normal deviate at 95% confidence level = 1.96; σ is population standard deviation obtained from past research and here it is 0.76; e is the acceptable margin of error and usually considered as 0.10; N is the population size.

The English structured questionnaire was translated to dholuo language for easy understanding by the respondents. We also divided the questionnaire into two parts: (a) personal and professional characteristics of the farmers and (b) their opinion towards floating agriculture and at this part 20 opinion measurement statements were employed.

3.0 Measurement Techniques of Different Variables

3.1.1 Measurement Techniques of Dependent Variable

The opinion of the farmers towards utilization of their water-logged farms as planting medium post flooding is the dependent variable of this study. The questionnaire contained 20 statements which were administered for judging the farmers opinion. The opinion statements were aligned with the three areas elaborating advantages of embracing floating gardening, ecological, agricultural and social-economical areas (Haseeb, 2011). The farmers were asked to indicate the extent of their agreement on each of the 20-statement utilizing a Likert-type five points scale like strongly agree, agree, undecided, disagree and strongly disagree with assigned scores of 5, 4, 3, 2 and 1, for positive statements, respectively and vice versa for negative statements. Different scales are used for measuring opinion of the respondents, although the Likert scale is the most widely utilized technique for opinion measurement (McLeot, 2008) and was therefore employed to obtain respondents on the basis of agreement or disagreement of the 20 statements.

3.1.2 Calculation of Reliability of the Opinion Statements in the Questionnaire

We measured the reliability of the opinion statements in the interview schedule with the help of Cronbach's Alpha test, as this test is the reliability indexing method associated with fluctuation and the Alpha coefficient varies from 0 to 1 (Santos, 2015).Increase of Cronbach's Alpha dependends on the increase of inter-correction among the test items. For the current study, the Cronbach's Alpha was calculated using the formula below:

$$\alpha = \frac{\overline{kc}}{(\bar{V}+(K-C)\bar{C}}$$

where, K is the number of scale items is the average variance of each component (item), and c is the average of all covariances between the components across the current sample of persons (that is, without including the variances of each component). We calculated the Cronbach's Alpha of 10 respondents' opinion statement and the value was 0.832. The commonly accepted rules of thumb to explain internal consistency of the value of Cronbach's Alpha is as like, > 0 .9 is Excellent, > 0.8 is Good, > 0.7 is Acceptable, > 0.6 is Questionable, > 0.5 is Poor, and < 0.5 is Unacceptable (GEORGE, 2016). So, the opinion statements of the current questionnaire were reliable based on the value of Cronbach's Alpha.

3.2 Measurement of Independent Variables

There were eight independent variables of the study and those were farmers' age, level of education, family size, farm size, family annual income, extension media contact, training participation on smart agriculture and knowledge on floating agriculture. Age of a respondent was measured by counting the years from the time of his/her birth to the time of interview. The level of education was measured by the number of years of schooling. Family size was measured by the total number of members including the respondent himself, spouse, children and other permanent dependents who lived together as family unit. The farm size possessed by the farmer under farm including share cropping and waterlogged farming land was the basis of measuring farm size and which was expressed in hectare for the current study. Family annual income of a respondent was determined on the basis of his total earnings from agriculture, service, business, and other sources. For measuring social media contact of the respondent, a four-point scale i.e., not at all, rarely, occasionally and frequently was used and appropriate weights were assigned to quantify the variable as against five different types social media and assigned scores were 1, 2, 3, and 4, respectively. Training participation on floating agriculture was measured by the total number of days that a respondent had encountered training experience in his entire life from different agricultural related organizations and from other organizations of smart agriculture. Meanwhile, the farmers' knowledge on floating agriculture was calculated by answering 15 questions related to floating agriculture. The assigned score against each correct, partially correct and incorrect answer was 2, 1, and 0, respectively.

3.3 Statistical Analysis

Statistical Package for Social Science (SPSS) version 16 was used for analyzing the data. We calculated the mean and standard deviation to achieve the objectives of the study and used different categories for classifying the data. Different statistical tests like frequency count, percentage, mean, and standard deviation were applied to analyze and interpret the

data based on the purpose of the study. To explore the relationship between the sociodemographic characteristics and the opinion of the farmers and for quantifying the influence of all of the eight independent variables on the dependent variable, we utilized multiple regressions with 0.05 and 0.01 level probabilities. The multiple regression proceeds with the formula, below:

$$y = \beta_o + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta k x k + \epsilon$$

where, y is the probability of the dependent variable, that is opinion under the eight independent variables: X1, X2 ……., Xn indicate the variables such as age, education level, extension media contact, training participation etc. while β1, β2, ……., βn are the coefficients of regression analysis of independent variables. β0 is constant.

4.0 Results and Discussion

4.1 The Characteristics of Nyando Topography Influencing Its Suitability for Floating Agriculture.

River Nyando basin is characterized by steep gradient of the terrain, and therefore, the basin experiences high level of soil erosion and thereby silting the river and drainage channels.There are several Water channels within Nyando basin including rivers, streams, swamps, lakes etc. the river and streams flow through which water flows in the lower Nyando river basin are: River Nyando , Miriu stream , Awach stream , Sondu river ,Nyalbiego stream , Omondo stream ,Asawo stream ,Nyaidho stream (Olang, 2011) .The gradient of Nyando is generally a slope of land. In the highlands the slope is steep, water therefore flow at a high speed. The water carries a lot of debris to the lowlands, which get deposited in the channels due to low speed. The deposits make the channels shallow and may also block them, causing the water to overflow the traditional channels, resulting to floods (Onyango, 2005).Also the type of soil for example the lower Nyando river basin has black cotton soil (clay soil) which has fine particles. The fine particles close up when wet, reducing the rate of water infiltration into the soil. A lot is therefore retained on the surface causing flooding. Heavy vegetation blocking the water channel causes the water to overflow the already shallow channels thereby causing floods as agreed by (Ochola, 2010). The study therefore agreed that the land gradient, water channels and type of soil of Nyando sub-county makes integrated hydroponics a suitable farming venture in the region.

4.2 The Farmers opinion towards exploration of waterlogged farms for floating gardening

The study aimed to assess farmers' opinions on the utilization of waterlogged farms for floating gardening. The questionnaire collected and calculated 20 opinion statements, which were grouped into three exhibits. The highest-ranked statement expressed a negative view of floating agriculture as wasteland, while the second and third ranked statements highlighted farmers' willingness to establish themselves in this profession and the potential of floating agriculture to adapt to post-flooding conditions and increase annual family income. These findings indicate that farmers recognize the economic, environmental, and agricultural value of floating agriculture. The technique offers sustainable fresh produce supply even in flood and waterlogging conditions, and its eco-friendly and organic nature requires less investment. Previous studies have also shown that floating agriculture is an environment-friendly production technique that contributes to food security and can effectively combat poverty and hunger during waterlogging and flood situations.

Floating agriculture requires less capital investment and labor compared to traditional agricultural practices, utilizing locally and readily available raw materials, making it an economically sound option. Additionally, it serves as a source of income for unemployed individuals, including women, and provides multi-sectoral benefits from economic, ecological, social, and cultural perspectives for farmers and local communities. The practice has been sustained for over 100 years in some regions of Bangladesh, indicating its long-term viability and sustainability. Proper planning and management of floating agriculture can significantly contribute to agricultural production, the environment, and the socio-economic well-being of the Nyando region.

The study identified the main waterlogging regions in Nyando sub-county, including various swamp and littoral zones, lacustrines, pulistrines, the River Nyando and its tributaries, and rice irrigation schemes. These regions cultivate a wide range of crops such as rice, tomato, spinach, potato, chilies, amaranth, papaya, cucumber, watermelon, onion, garlic, and kales. Floating gardening provides farmers in these waterlogged areas with the opportunity to grow diverse crops, ensuring food supply even during adverse flooding and waterlogging conditions. Understanding the socio-demographic characteristics of the farmers residing in these areas is crucial for effective planning.

The study examined eight socio-demographic factors, including age, educational attainment, family size, farm size, annual income, extension contact, and training received. The majority of farmers were below 30 years of age, with a significant proportion educated at the primary, secondary, or tertiary level. The respondents generally had medium-sized families and small farm sizes, indicating an interest in exploring floating agricultural activities. The average income of the respondents was Ksh. 50,000, and the majority had low to medium extension media contact and no training exposure to smart agriculture. Strengthening the services of the County Department of Agricultural Extension could support farmers in this regard.

The knowledge scores of farmers on floating agriculture ranged from 16 to 24, with an average score of 19.97. The results indicate that 82% of the farmers possessed good knowledge (60% to 80% correct) on the benefits of floating agriculture. Although the practice is yet to be launched in the study area, respondents demonstrated a solid understanding of general agriculture. Improved knowledge in the use of floating agriculture can enhance individuals' confidence in practicing this specific type of agriculture for many years

5.0 Conclusions

This study was conducted to assess the farmers' opinion towards utilization of wetland for floating agriculture as a means of adapting to the devastating effects of recurrent Nyando flooding events. Important findings exhibited that most percentage (95%) of the farmers in this study were in between 50 years of age, while about 84% of them were educated either primary, secondary or more. The average family size of the farmers was 5.20, while 91% of the farmers had the family size from 4 to more than 6. Although the farmers of the study area had smaller (88%) farm size of 0.02-1.01 hectare. The average family annual income of the farmers was Ksh.50,000. The farmers of the study area had low to medium (71%) extension contact and 96% of them did not receive any training on climate-smart agriculture and related issues. Meanwhile, 82% of them had 60-80% correct knowledge on general agriculture. Hence, these factors might affect their opinion towards floating agriculture as a means of wetland utilization for floating agriculture as a post flooding adaptive measures for the farming households. About 83% of the farmers maintained moderately to less favorable opinion towards utilization of the waterlogged wetlands for agriculture as a means adopting to recurrent floods. Additionally, farmers age, their family size and training participation on agriculture had an influence on their opinion towards floating agriculture. These findings indicate that higher level of these three characteristics will result higher of the opinion of the farmers towards floating agriculture as a means of adaptive smart agriculture. Moreover, Nyando topography provides appropriate characteristics suitable for floating agriculture especially during rainy seasons. The farmers should be provided with different types of need-based training related to floating agriculture. Hence, the government and non-government organization should take proper steps with this regard.

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THE INFLUENCE OF HUMAN ACTIVITIES ON THE ECOSYSTEM (ACASE STUDY DUNGA BEACH KISUMU)

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ABSTRACT

Ecosystem is defined as the system resulting from the integration of all the living and non-living factors of the environment. Human activities have been the primary causes of destruction of the natural aquatic life together with the plants growing along the beaches. Fish species have significantly dropped to below 50% in Lake Victoria. The community should be educated to concentrate their efforts in conservation of the natural resources in their areas. The objectives which directed the study include; determining the domestic activities done along the beach, establish the effect of wastes disposed to the ecosystem and to explore the economic activities to the ecosystem. Descriptive design was used that adopted the use of both questionnaires and interview to gather quantitative and qualitative data. The sample frame was the beach along the Lake Victoria which was Dunga beach. Simple random sampling technique was used to reach the target population which included fishermen, farmers and local residents with a sample size of forty. The finding indicates that people bath and clean utensils along the beach. Majority carry out domestic tasks along the beach to ease their work. Fishing, farming, and car wash are economic activities on the beach. Pesticides are used while farming along the beach with car wash emits waste into the ecosystem. Both sex carries out most of their domestic activities along the beach. Household waste and company waste are both disposed along the beach which pollutes the lake. The population greatly depends on the lake for livelihood. The fish species and population is depleting rapidly due to human activities. The study recommends further research on the effect of pollution in the ecosystem, tourism strategic policy making in the protection of Lake Victoria and local empowerment in the protection of natural resources

Key Words: **Pollution, Ecosystem, Natural resources.**

1 Introduction

Dunga beach Kisumu is one of the beaches along the Lake Victoria region it has been affected significantly with the water bloom. This gives the shelter to undesirable insects including mosquitoes. It's also kills species of fish, domestic animals and birds and the water also stinks. They generally reduce the natural beauty of the Lake Victoria which is the largest lake in Africa and second widest freshwater body in the world.

2 Literature Review

Ecosystem is the system resulting from the integration of all the living and non-living factors of the environment. A.C Tansley (1935). Various ecologists have added much on this concept. (Linde man, 1942; Odum, 1963 and 1971; Billings, 1964; Misra, 1969, Mac Fadyen, 1964). Different terminologies have been used to explain the term ecosystem to explain the idea like biocoenosm, microcosm, biocoenosis or geobiocoenosis, holocoen, biosystem, bionesy body and ecocosm. Barrett (1978) proposed a new term noosystem to define a basic unit of study encompasses biological physical social, economic and cultural influence on the total system. The human activities and climate have interacted synergistically to impact the relationship between social and ecological system in the late 20th (Steffen 2005)

The impact of human activities on natural landscape ecology is very fragile due to the limited resources (Luo and Zhang, 2006) China. Domestic and industrial activities have greatly contributed to increasing scale of pollution of rivers and other water bodies (Ibch and mbat, 2007). Zanzibar is typical of small island state in the developing world whose economy is based on activities that are sensitive to changes in climate such as Agriculture, seaweed farming, and tourism (Gossling and Hall, 2006)

20% of gross domestic income of Kenya is derived directly or indirectly from the coastal economies but inadequate management of the marine resources has resulted in over exploitation, habitat destruction pollution, and coastal erosion that diminish the value of coastal resources and activities (Payet and Obura, 2004). The increased growth of aquatic plant which is often an algae blooms form a dance floating mat "blanket" on the surface of the water. The extensive algae growth has resulted in fish kills by interfering with re-aeration excluding light intensity necessary for other aquatic plants and thereby preventing the release of oxygen into water or depleting oxygen through decay or respiration within the bloom. When density of the bloom becomes sufficient to reduce the intensity of solar light below the surface.

3 Research Methodology

3.1 Objectives of the study

- To determine the domestic activities along Dunga beach in Kisumu
- To establish the effect of wastes those that are disposed to the ecosystem in Dunga beach Kisumu.
- To explore the economic activities to the ecosystem in Dunga beach Kisumu

3.2 The Study Area

The study was carried out among the fishermen, farmers and the local residents of Dunga beach area.
The sample frame of the beach along the Lake Victoria is Dunga beach

3.3 Research Design

Descriptive design was used that adopted the use of both questionnaires and interview to gather quantitative and qualitative data questionnaire that are relevant to the study because there are some variables which need to be described using words and others using numbers that was directed to respondents. The interview is a qualitative method and it was also used to ask questions. The questionnaires were pre-tested to allow simple questions first and the difficult ones at the end.

Simple random sampling technique was used to reach the target population the sample size was fifteen respondents. The sampling was useful because it ensured all segment of respondents were researched. The researcher chooses randomly with the number of questionnaires available.

3.4 Data Collection

The researcher used both questionnaires and Interviews
The questionnaires were short and precise to allow the respondent ease to answer all questions.
Each item in the questionnaire was developed to address specific objectives and research questions. The questionnaires are cheap and they reduce biasness of errors that are likely to occur during the data collection process. It was useful to get honest opinions because of the sensitivity of the research topic. The researcher also read and translate the questions to local language to allow the respondent to answer and recording the information

3.5 Data Analysis

The researcher analyzed all the data f manually where all the variables and respondents were assigned numerical value to ease tabulation and analysis. by use of frequency, percentages, averages and accumulative frequency. Graphs tables and pie charts will be used to represent the data of the study.

4 Results and Discussion

The study findings suggest that domestic activities along the beach, such as bathing and cleaning utensils, are common among the respondents. The perception behind cleaning utensils along the beach is that it eases domestic work. Waste disposal along the beach is also prevalent, with both household and company waste

being disposed of in the lake. A majority of respondents agree with this practice. Economic activities like fishing, farming, and car washes take place along the Dunga beach. Farming activities involve the use of pesticides that wash away into the lake, according to the respondents. Car washes also contribute waste to the ecosystem along the beach

The study concludes that the population along Dunga beach consists of both men and women in equal percentages. Recommendations include further research on pollution's effects on the ecosystem, the formulation of tourism strategic policies for Lake Victoria's protection, and local empowerment in safeguarding natural resources. Additionally, the study suggests that the county government of Kisumu should implement water control policies.

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PRODUCTION PRACTICES, CHALLENGES, USES AND CONSUMPTION OF GUAVA PRODUCTS IN GENDIA WARD, KENDUBAY SUBCOUNTY, HOMABAY COUNTY, KENYA

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ABSTRACT

This study was conducted in Gendiaward,inKendu bay subcounty.Methodology applied was survey of the study areaPrimary data was collected from 120 guavafarmers to identify factors affecting guavaproduction in kendu bay. The results indicate that oldplanting material, poor management practices, extensive fruit drop and attack of insect pests and diseases are major factors that affect guava production It was investigated that growers do not follow recommendations made by scientists particularly about inputs requirements, because they do not know advantage of proper application of inputs. The results further show that 68 percent variation in guava production is explained by included explanatory variables. Number of inter-culturing and soil type are significant at 1 percent level, whereas, coefficients of number of guava trees, farm yard manure (FYM), fertilizer and number of labour engaged are significant at 5 percent. Area of farmland devoted to guava production is not significant. Moreover, major production inputs such as pesticide sprays, fertilizer, FYM and labour for orchard management are under utilized, affecting guava production.

Keywords: Psidiumguajava, production factors, farm inputs;, farm management.

1- Introduction

Guava (Psidiumguajava), the apple of tropics, is a common fruit in Kenya Mature guava fruits, freshly plucked from tree, have a sweet and attractive flavour. Fruit is largely eaten fresh, but is also used in jellies and jams. Fruit contains 82 percent water, 0.7 percent protein, 11 percent carbohydrate and desirable amounts of vitamin A, B. C, minerals and high amount of pectin. It contains three to six times more vitamin C than oranges, 10-30 times more than bananas and about 10 times more than papaya. Guavas are also useful source of calcium, nicotinic acid, phosphorous and soluble fiber. These are very good for immune system and are beneficial in reducing cholesterol and protecting the heart. Like other fruits ad vegetables, guava contains no saturated fat, sodium or cholesterol. There are about 25 calories per guava, thus experts give maximum marks in terms of it's nutritional value. It is a tropical tree and adapts itself to most conditions of soil and climate. Among major fruits of arid climates in Kenya. guava occupies third position after citrus and mango in terms of area and production.

2- Literature Review

The gap between potential and actual yield occurs due to poor management practices and post harvest losses. It is believed that guava production system has been transferred from previous generations and is dominant among the growers. Traditional methods are commonly used in guava management where labour is an important input in guava production process. Production process is not mechanized and is mostly labour intensive. Majority of growers do not follow modern practices like proper use of FYM, interculturing, fertilizer application, sprays and timely irrigation. Problems of post harvest lsoses include improper handling, immature fruit harvesting and inadequate transport and storage facilities. Post harvest losses are estimated at 20 to 40 percent of total fruit production in Kenya The present study aims to broadly overview guava production practices being

Followed by guava producers and also to identify technical and socioeconomic factors, which limit guava production in Kenya.

3. Research Methodology

3.1 Study area

This study was conducted in Gendia ward Kendu bay sub county. A primary survey of guava producers in major guava growing area in the study area was made and data from 120 guava farmers was randomly selected,given their characteristics that was fit for the study. Gendia ward is approximately 27km from kendu bay town.it is located to the north of lake Victoria.the most prominent land mark is Gendia mission hospital.it covers an area of 245km square and a population 4789 as of population census of 2020. 65% of this population live below the poverty level.Climate is semi arid hence supports guava production.short rains are experienced between March and may with temperatures ranging from 27-29 degrees celcious.

3.2 Data collection procedure

Initially an informal survey of guava producing area was carried out to understand existing guava production system. Open ended interviews were held for each category of respondents to identify key issues and variables. Sampling frame was prepared and interview checklists and general questions of land allocated to guava production were refined. Distribution of selected sample size was determined depending on the size.

3. Findings

3.3.1 Farm size and guava orchard:

Previous studies have shown that smaller farms tend to be more productive due to higher land use intensity and efficient family labor. However, larger farms may have better access to resources like irrigation water, credit, and technical knowledge, which can contribute to their higher productivity. In the case of guava production in Kenya, small growers were found to allocate a larger portion of their land to guava orchards compared to medium and large growers. They focused on maximizing guava orchard area, while larger growers expressed interest in converting more of their land to guava orchards.

Small growers maintained the fertility of their guava orchards by regularly using farm yard manure (FYM). Applying manure in a ring around the tree improved plant health and increased flowering. However, growers did not follow recommended nutrient guidelines provided by extension officials. Fertilizer use among guava growers was relatively low, with limited application of urea and diammonium phosphate (DAP) per acre. The significance of potassium, an essential nutrient for guava trees, was not recognized by the growers. Yield variations among different farm sizes were inconsistent.

Plant population, management practices, and pest and disease attacks influenced yield variations in guava orchards. Optimal yield was achieved with a spacing of approximately 55-52 trees per acre. Intercropping was economically feasible during the early stages of establishment but not when trees were fully grown. Factors such as planting material, plant spacing, soil type, and irrigation availability were important for guava yield.
A Cobb-Douglas production function was used to analyze the input-output relationship in guava production. Regression analysis revealed that interculturing, soil type, and labor engagement significantly influenced guava production. However, the land area dedicated to guava production did not have a significant impact. Marginal value products (MVPs) and allocative efficiency parameters indicated underutilization of major inputs like pesticide spray and labor. Increasing investment in these inputs and improving management practices could enhance guava production. The study emphasized the importance of small growers in maximizing guava production through efficient land use and labor utilization. It also highlighted the need for better adoption of recommended practices, such as nutrient management and intercropping, to improve guava production in Kenya.

4. Conclusion and Recommendations

The foregoing analysis has indicated that major production inputs such as pesticide sprays, fertilizer, FYM and use of labour for management practices are underutilized, affecting guava production. It was also investigated that guava producers do not know the advantages of proper use of inputs such as sprays and fertilizer. They think that application of fertilizer in fruit orchards encourages the vegetative growth of plant and does not increase guava production. Use of chemical sprays and use of labour appear to be limited by available resources with guava producers. It is, therefore, suggested that proper dose of chemical fertilizer and timely use of chemical sprays are essential to achieve better guava production.

Moreover, it is also recognized that some social factors are playing an important role in process of guava production. These have not been included in this analysis because of difficulties in their quantification and non-availability of data. This however, does not reduce the importance of assessing their impact on economic development, particularly in developing countries where social institutions are relatively more important both from view point of helping or hampering the development efforts. The major problems in guava production identified are: old planting material, poor management practices, extensive fruit droppage and attack of insects and pests. It is clearly indicated that this sector has a tremendous scope for future expansion of production and export performance. This would be possible by screening existing potential planting material as it has the potential to improve production upto 30- 40 percent when combined with improved management practices and adoption of scientific recommendations. Guava uses are apart from being a nutritious supplement,its also medicinal and the leaves are also major weight loss suppliments natural and healthy due to their antioxidants property.

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HOMESTAY TOURIST ACCOMMODATION AS PROMOTIONAL TOOL FOR LOCAL FOOD PRODUCTION IN NANDI COUNTY

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ABSTRACT

In Kenya, achieving food security has been challenging, with small-scale farming contributing about 75% of the total agricultural output. To ensure food security in the country, it is crucial to prioritize the welfare of small-scale farmers who offer homestay tourist accommodation services. Unfortunately, despite many research identifying various intervention for improving food production in Kenya, there has been limited knowledge on the role of homestay tourist accommodation in promoting food production in rural areas. Therefore, the current study explored types of food produced for homestay tourist accommodation, tourist experience of locally produced food and its influence in promoting local food production in Nandi County. The study purposively sampled 78 homestay tourist accommodation services providers and 16 tourists in rural areas in Nandi County, Kenya. The study was anchored on Skinner's theory of motivation. Descriptive research design was employed. Data was collected using both open and close ended questionnaires and interview schedules. Data was analyzed using descriptive statistics. Qualitative data was thematically coded and analyzed through text analysis. Findings showed that there was positive significant relationship between tourist food experiences, satisfaction and local food production. Descriptive results showed that food that had high experience and satisfaction among tourist were highly produced. Some of the tourist suggested donor support toward increasing some of local foods produced in Nandi County. The findings imply that promoting local food production can be a win-win situation for both the tourism industry and the local community in Nandi County. By offering authentic and locally sourced foods to visitors, the tourism industry can attract more visitors and generate economic benefits for the local community. At the same time, increased demand for local foods can help to support local farmers and producers, and preserve traditional culinary practices.

Keywords; Homestay Tourist Accommodation, Local Food Production, Tourist Experience

1.0 Introduction

The promotion of cultural food production is a big driver of climate change (European Commission, 2022) and the food system is under threat and needs to become more resilient and sustainable. However, However, in developing nations local food production has decreased across sub-Saharan region (van Zonneveld, et al., 2023) due to the promotion of export-driven agriculture, urbanization, and a decline in agrobiodiversity and ecosystem functions, along with a growing preference for imported foods and Westernized diets (Bedeke, 2023).). Concurrently there has been a financing and investment crisis in agriculture, leading to lack of extension services and technical support for farmers as well as lack of improved tools and plants, and difficulty in accessing credit (Farthing,et al., 2023).

Authors Scheyvens and Laeis (2022) suggest that strengthening food producer linkages with the tourism industry can contribute to achieving the United Nations' Sustainable Development Goals (SDGs) by promoting local food systems and enhancing the tourism sector. In the context of homestay tourism, food plays a crucial role in meeting the needs of guests, and increasing demand for local food products benefits farmers and other food producers. Homestay tourism is a growing and trendy concept with potential for significant growth and income generation, particularly in relation to local farming.

Homestay tourism in rural communities offers natural and cultural attractions, benefiting both economically and culturally (Thakur et al., 2023). In India, it promotes local art, architecture, traditions, and food habits (Thakur et al., 2023). Community-based ecotourism in Cambodia aims to preserve natural environments and traditional local food production (Sen & Walter, 2020). In Africa, homestay tourism reduces rural poverty, provides foreign currency earnings, and stimulates economic development (Janjua et al., 2022; Budhathoki, 2013). In Kenya, homestays contribute to sustainable economic growth, poverty reduction, and achievement of national development goals (Ole Peteny, 2016; Gok, 2007). The certification of homestay sites is seen as a means to enhance the quality of life for local communities (Vision 2030-MTP, 36; DoT, 2011). However, the specific contribution of homestay tourism in Kenya is yet to be determined.

Given the above challenges, this research aims to test the assumption that building strong linkages between homestay tourism and local food production systems, especially agriculture and fisheries, is possible, and desirable, and would lead to more sustainable development. This article, considered whether tourism businesses can deliver on the SDGs particularly with regard to food-related goals.

2.0 Review of literature

Local food culture plays a crucial role in community-based homestay tourism, offering visitors opportunities to engage in cooking, eating, and exploring food-related activities (Pusiran et al., 2021). The satisfaction of guests in community homestays is heavily influenced by their experience of local food (Tiwari et al., 2020). While host families are encouraged to incorporate local food culture, training manuals provide flexibility in terms of meal arrangements and enjoyable taste preferences for visitors (MoTCA, 2010; ASEAN, 2016; SNV, 2014). Aziz et al. (2014) found that local food significantly impacts tourist satisfaction in homestay operations in Malaysia, particularly through traditional food experiences. However, cleanliness and hygiene concerns, especially regarding water, were raised by visitors. Jamaludin et al. (2012) also highlighted the appreciation for local cuisines and traditional activities in homestay tourism operations. They suggested creating unique food specialties in each village to enhance visitors' memories. Kunjuraman and Hussin (2017) identified the lack of basic infrastructures as obstacles to meal preparation and homestay activities in a seaweed cultivation program.

Food is an important aspect of travel experiences, connecting with the place, its people, and cultural traditions (Long, 2004; Björk & Kauppinen-Räisänen, 2014). Travelers often seek unique food experiences when visiting new destinations, and positive food experiences can inspire changes in their dietary habits (Björk & Kauppinen-Räisänen, 2014; Bertella, 2020). Although local food culture is not the primary motivation for visiting rural Norwegian destinations, it is generally recognized as part of the overall travel experience (Frisvoll et al., 2016).

Chitrakar (2022) explored the impact of community-based homestay tourism on local food culture in Nepal. The findings revealed that tourism significantly influences food culture, extending beyond tangible aspects to include intangible socio-cultural elements within the local community. Community homestay tourism has led to the expansion of local food culture, incorporating influences from regional and international cuisines, promoting experimentation, creolization, and the revitalization of traditional feast patterns and festive dishes

3.0 Research Methodology

Convergent parallel mixed methods design was preferred because it is a form of design where the investigator converges or merges quantitative and qualitative data in order to offer a comprehensive analysis of the research problem. In this design, the researcher normally collects both types of data roughly at the same time and then integrates the information in the interpretation stage of the overall results.

3.1 The Study Area

The target population was 78 homestay tourism service providers and estimated 1217 tourist seeking homestay accommodation services annular in Nandi county. Nandi County is a county in Kenya in the North Rift, occupying an area of 2,884.4 square kilometres. Nandi County is endowed with rich, unique and diverse tourist attractions including beautiful geographical landscape, scenic tea plantation and bird habitat in the South and North Nandi Forests. Other attractions include a variety of flora and fauna, rich cultural history including the Nandi County and legacy of Koitalel Samoei, Sheu Morobi, Abundant rock formation and hills. purposive sampling from the non-probability sampling technique was used to purposively pick twenty-one (34) homestay tourism service providers and 16 tourist . Purposive identification of these respondents was based on their unique experiences and expertise in homestay tourism. Thus, they had important information on the topic under study and were appropriate for interviewing using interview guides

3.2 Data Collection

The study used structured closed-ended questionnaires with specific questions were to collect numeric quantitative data. The study also used Interview schedule to collect data.

3.3 Data analysis

3.3.1 Quantitative Data Analysis

During quantitative data analysis, data was prepared by editing it for completeness, accuracy, and consistency. Descriptive statistics was done by generating means and standard deviations and was statistically analyzed in line with the study objectives. The analyzed result was counterchecked for likely incorrect entries at this point and appropriate corrections were made in order to avoid any errors. Inferential statistics was done to draw conclusions and generalizations concerning the population. Pearson correlation was utilized to determine the strength of the relationship between the independent variable on the dependent variable.

3.3.2 Qualitative Data Analysis

Qualitative data was gathered using an interview guide and thematically coded and analyzed using text analysis method where content matter of responses were transcribed into text. This research grouped interview responses with familiar themes or pattern into coherent categories. The data was then thematically coded such that similar themes were categorized and filed together, organized, summarized, and presented in express quotations of pertinent verbatim responses and chosen comments. Themes interpretation was then made to construct and explain the participants' meaning or understanding of the situation.

4.0 Results and Discussion

Demographic details can be useful for further analysis, such as understanding potential variations in attitudes, behaviors, or preferences among different host groups within the context of promoting local food production through. The majority of hosts are female (57.4%), and there is a relatively equal distribution across age groups, with the highest representation in the 36-41 years age range (47.2%). In terms of experience, the majority of hosts have been engaged in Homestay tourism for 4-7 years (54.5%).

4.1 Hosts' attitudes towards Homestay Tourist Accommodation as a promotional tool for local food production

Overall, the hosts had a positive attitude towards promoting local food production through Homestay Tourist Accommodation. The mean score of 4.18 indicated that the hosts generally agreed with the statements about the benefits of Homestay Tourist Accommodation for local food production. The standard deviation of 0.71 indicated that there was some variation in the hosts' attitudes, but overall, they were supportive of Homestay Tourist Accommodation as a promotional tool for local food production.

The statement with the highest mean score was "I actively sought opportunities to connect with local food producers and incorporated their products into the experience I offered to guests." This suggested that the hosts were interested in providing their guests with an authentic experience that included local food. The statement with the lowest mean score was "I was committed to adopting sustainable agricultural practices in promoting local food production through my homestay." This suggested that the hosts were less concerned about the sustainability of local food production than they were about providing their guests with a good experience.

The results of this survey suggested that Homestay Tourist Accommodation had the potential to be a successful promotional tool for local food production. The hosts were generally supportive of the idea, and they were interested in providing their guests with an authentic experience that included local food. However, the hosts may have needed more information about the benefits of sustainable agricultural practices in order to be more committed to adopting these practices

4.2 Guest' attitudes towards Homestay Tourist Accommodation as a promotional tool for local food production

The guests had a positive attitude towards homestay tourist accommodations as a promotional tool for local food production. The mean score of 4.03 indicated that guests generally agreed with the statements about the benefits of homestays for local food production. The standard deviation of 0.72 indicated that there was some variation in guests' attitudes, but overall, they were supportive of homestays as a way to experience local food and culture.

The statement with the highest mean score was "Homestay accommodations offered a more authentic and immersive experience of local food production than traditional hotels." This suggested that guests were interested in experiencing local food and culture in a more authentic way than they could in a traditional hotel. The statement with the lowest mean score was "I was more likely to choose a homestay accommodation if it promoted and supported local food production." This suggested that guests were not solely motivated by a desire to support local food production when choosing a homestay accommodation. However, they were still more likely to choose a homestay accommodation if it promoted and supported local food production.

The results of this survey suggested that homestay tourist accommodations had the potential to be a successful promotional tool for local food production. Guests were generally supportive of the idea, and they were interested in experiencing local food and culture in a more authentic way than they could in a traditional hotel. However, guests may not have been solely motivated by a desire to support local food production when choosing a homestay accommodation

4.3 Qualitative analysis

Interviews were conducted and the following themes emerged. In the process of analysis and data presentation, each participant was assigned a code from I-01 to I-16

4.3.1 Vegetarian guest

Vegetarian homestay guests played a crucial role in promoting local food production. By choosing to stay with a host family that prepared vegetarian meals, guests supported the local economy and created a demand for locally-grown, plant-based foods. They also had the opportunity to learn about local food production firsthand through interactions with hosts and visits to farmers markets and food producers. Hosting vegetarian guests allowed hosts to contribute to the local economy and environment, educate guests about the benefits of a plant-

based diet, and inspire them to continue supporting local food systems. Vegetarian families in homestays were seen as ethical entrepreneurs who excelled in offering vegetarian meal options using fresh organic ingredients, showcasing their culinary skills, and providing a positive food experience.

4.3.2 Innovation to the local food

Homestay guests brought new ideas and perspectives to the local food scene, leading to innovation in promoting local food production. They shared cooking techniques, ingredients, and traditional recipes, fostering cultural exchange and promoting local cuisine

These findings support Robertson's (2012) concept of glocalisation, where local food culture reacts to globalisation through a synthesis of global and local elements. Globalisation can trigger the process of glocalisation, leading to creolisation (Mak et al., 2012) and diversification of local food (Richards, 2012c). Ishak et al. (2013) also highlight how interaction between local cultures inspires changes in food culture. Despite modifications, tourism positively strengthens local traditional food heritage

4.3.3 Changes in locals' taste preferences

Homestays positively influence locals' taste preferences for local food by exposing them to new foods and flavors from different cultures. This broadens their horizons and makes them more receptive to trying new things. Homestay guests also educate locals about the significance of local food production and the benefits of consuming locally. Ojetunde et al.'s (2021) study in the United Kingdom supports these findings, showing that homestay students developed a preference for local food and were more likely to support local food systems. Homestays thus serve as an effective means to promote local food production and transform locals' taste preferences, contributing to a more sustainable food system.

4.3.4 Nutritional change

Homestay tourism has led to improved nutrition among host families, with increased awareness of healthy food patterns and balanced diets. Homestay guests' interactions with host families expose them to new foods and flavors, expanding their culinary horizons. They also provide insights into the importance of local food production and the benefits of eating locally. Host families benefit from learning about new food trends, such as gluten-free options, food allergies, and organic food. Interviews with homestay operators indicate a positive change in meals, including a wider variety, increased consumption of fruits and vegetables, and knowledge of nutritional components. These findings align with Leatherman and Goodman's (2005) argument that tourism can positively impact community nutrition by enhancing food diversity and quality.

4.3.5 Food sourcing

Homestay tourism has played a significant role in promoting local food sourcing and production. Host families were motivated to engage in organic farming and use homemade products after realizing that tourists appreciate these practices. The awareness of the increased use of insecticides and pesticides in commercial farming prompted families with farmland to expand their organic food production. Even families with limited farmland embraced kitchen gardening and experimented with roof farming for vegetables and flowers. The availability of fresh and organic vegetables from terrace gardens and locally sourced meat has reduced reliance on processed and canned foods. Overall, homestay tourism, despite being a small-scale cooperative business, has had a positive impact on local food production.

4.4 Conclusions

the survey results revealed a positive attitude among both hosts and guests towards Homestay Tourist Accommodation as a means of promoting local food production. Hosts actively sought opportunities to collaborate with local food producers, recognizing the community benefits of promoting local food through homestays. Guests saw homestays as a chance to immerse themselves in and appreciate local food production, enhancing their understanding and connection with the local food culture. Both hosts and guests supported the idea of offering an authentic experience that includes local food. However, hosts showed less commitment to sustainable agricultural practices compared to their focus on guest satisfaction. Vegetarian guests and hosts

played a significant role in promoting local food production by supporting the local economy and sharing knowledge about plant-based diets. Homestay guests also introduced new ideas, cooking techniques, and ingredients, contributing to the diversification and strengthening of local food heritage. The interaction between homestay guests and locals broadened locals' taste preferences and motivated them to support local food systems. Homestay tourism also had a positive impact on the nutrition of host families, raising awareness of healthy food patterns and balanced diets. Overall, the survey findings demonstrated that homestays effectively promoted local food production through positive attitudes, collaboration, cultural exchange, and the cultivation of sustainable food practices.

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3. SOCIAL SUSTAINABILITY

SOCIO-CULTURAL VALUES AND THEIR INFLUENCE ON ECONOMIC DEVELOPMENT CASE STUDY OF ALEGO SUB-COUNTY, SIAYA COUNTY, KENYA

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ABSTRACT

The study focused on the issue of poor water quality and inadequate sanitation in slum areas, which leads to the prevalence of waterborne diseases. The use of pit latrines for waste disposal and drawing water from shallow wells contributes to the deterioration of water quality due to faecal coliforms. The objective of the study was to assess the levels of faecal coliforms in shallow well waters and determine the prevalence of waterborne diseases in order to establish the safety of water sources. Munyaka slums were chosen as the study area, where shallow wells serve as an alternative source of drinking water for a significant portion of the population. The research employed a descriptive design and stratified random sampling to select shallow wells and collect water samples for analysis of faecal coliform levels at the University of Eldoret Biotechnology laboratory. The study area was divided into three zones, and a total of 18 shallow wells were identified. Ten wells were selected, and duplicate samples were collected from each well. Thirty questionnaires were administered to well-owning households and their neighbors to gather information on water treatment and waterborne disease incidents. Data on waterborne disease patients were obtained from Amani Health Center. Statistical analysis was conducted using Excel software, and the laboratory results were compared to World Health Organization (WHO) standards. The findings revealed that all wells tested positive for the presence of coliform bacteria, with faecal bacteria contamination exceeding WHO drinking water standards. The minimum coliform count was found in Well5 (14/100 ml), while the maximum count was observed in Well10 (135/100 ml). The study also found that residents in Munyaka frequently sought medical attention for waterborne diseases. It was recommended that further research be conducted to assess the level of coliforms in other water sources in the area. Overall, the study highlighted the urgent need for disinfection of shallow well water in Munyaka due to its high faecal bacteria contamination. Addressing this issue is crucial to ensure safe and clean drinking water for the residents and reduce the incidence of waterborne diseases.

Keywords: Coliform, MPN test, shallow well, waterborne, slum.

1 Introduction

Development aims to enhance the quality of life for individuals, encompassing both economic and non-economic aspects such as personal freedom and culture (Agrawal and Lal, 1992). However, the determinants of social and economic development in a society remain a subject of debate. Some argue that social and cultural conditions shape economic development, while others contend that economic development defines society and culture. Surprisingly, even economists have increasingly recognized the influence of cultural change on economic development (Kindleberger, 1965).

Belief system theory, as presented by Rokeach, Grube, and Ball-Rokeach (1984), places values at the core of an individual's personality. Values play a crucial role in shaping attitudes and behaviors. Traditional and religious beliefs also hold significant importance in individuals' lives and have an impact on social and cultural aspects (Castelli and Gallup, 1989). In the United States, religious beliefs are pervasive, with a large percentage of the population actively participating in religious organizations (Gallup poll data). These beliefs can shape social and political movements.

Mayton, Ensor, and Anderson (1991) argue that the holistic development of individuals, families, and communities depends on balancing spiritual, personal, and material aspects of life. Such efforts can have secular benefits as well. However, Michael Porter (2000) suggests that it is the influence of "international economic culture" that is driving societies toward productivity and values conducive to a global homogeneous culture.
Powell and Biggs (2001) take a postmodern perspective on culture, emphasizing individualism, diversity, and the rejection of strategies that devalue individuals based on controlling access to knowledge. Vygotsky (1978) highlights the role of social interaction and cultural transmission in shaping cognitive functions and values. Individuals develop their values through interaction and socialization.

Max Weber (1958) argues that status values become cultural dimensions of prestige, influencing an individual's position and power within society's stratification system. Nominal characteristics held by individuals significantly impact their access to property and positions of power.

In summary, the relationship between socio-cultural values and development in a nation is complex. While opinions differ on whether cultural conditions shape economic development or vice versa, there is growing recognition that cultural change influences economic progress. Values, traditional beliefs, and religious motivations play a significant role in shaping attitudes and behaviors, impacting social and political movements. Balancing spiritual, personal, and material aspects of life can contribute to overall development. The influence of international economic culture and the promotion of individualism and diversity are also relevant factors. Finally, social interaction and cultural transmission shape cognitive functions and values, while status values impact social stratification.

The objectives of the study was to determine the relationship among socio-cultural values and gender and their effect on economic development among the residents of Alego Sub-County, Siaya County.

2.0 RESEARCH METHODOLOGY

The current study was conducted in Alego Sub-County, Siaya County based on both primary and secondary data. The primary data was collected by directly interviewing the respondents holding different positions at different levels of society with the use of interview schedule and making observations. 200 respondents were selected from four wards located in the western and southern parts of Alego to gather data by using multi stage systematic random sampling method. The collected data was analysed through statistical techniques.

Alego Sub County was purposively selected as the study location since it is the largest of the six sub-Counties of Siaya County, covering an area of 605.8 km^2 and is considered the most important socio-cultural heritage reserve in Kenya.

3.0 FINDINGS AND CONCLUSIONS

3.1 Demographics

While conducting the field survey for the study the age of the 200 respondents. 38.3% of respondents were found to be in the age group 36-45 years, 13.3% respondents were from the age group 26-35 years and the lowest percentage i.e. 8.3% of respondents are from the age group 55-and above years.

On the education level of respondents, the highest number (30%) of respondents were found having education level up to tertiary level and 2.5% respondents were found illiterate. Post graduate level respondents were 10% and graduate respondents are 23.5%.. The study thus revealed that present socio-cultural values in the context of education does not have much influence upon residents. This is due to the influence of some religious and traditional beliefs up on which residents are still bound to hold.

The income distribution of the respondents in the study area revealed that 27% of the respondents fell under the income group of 1,500 to 5,000, which had the highest number of respondents in the study area. The percentage of respondents decreased as the income groups increased, with the lowest percentage of respondents falling under the income group of 25,000 and above. This indicates that fewer people belonged to higher income groups. As most respondents had low earnings, they were unable to keep up with modern lifestyles and instead lived a traditional life with limited desires and luxuries. Consequently, fewer people in the study area were inclined to adopt modern values because it is money that enables individuals to embrace modern values and keep pace with the rapidly changing world.

3.2 Respondents in view of cultural beliefs as strengths

The study revealed that socio-cultural values and beliefs were firmly held by respondents. 46% of respondents firmly believed in religion and 41% of the respondents believed in witchcraft, 5.5% believed in polygamy. The belief and practice of wife inheritance and involvement in funeral ceremonies was found to exist, with 3.5% and 1.5% of respondents agreeing to it. Other cultural values and practices existed in the region, 2.0% of respondent acknowledged. Traditional planting rites were seen to be essential and upheld.

3.3 Respondents views regarding the changing gender roles

This was an independent variable that indicated the trend of socio-cultural values towards modern values. The first question examined whether men were better decision-makers than women. 105 respondents strongly agreed, while 10 respondents agreed. 32.5% of respondents disagreed. The second question aimed to determine if men were better planners than women. 144 respondents agreed, with only 40 in disagreement. The fourth question focused on whether university education was more necessary for men than women. 81 respondents strongly agreed, 69 agreed, and 35 disagreed. When asked if men should contribute 50% of their time to household chores, 115 respondents disagreed, and only 47 strongly agreed. In terms of both husband and wife having a job to contribute financially to the family, 86 respondents agreed, while 105 disagreed. Regarding the capability of women in politics, 61 respondents agreed, while 115 disagreed.

3.3 Respondents views regarding effect of socio-cultural Values on economic development

The responses of the respondents regarding the effect of existing socio-cultural values on economic development were examined as an independent variable. The first question aimed to determine whether existing socio-cultural values have a positive effect on economic development. Only 23% of the respondents agreed with this statement, while the majority, 70.5%, disagreed. The second question focused on whether religious values are the most important values shared by the residents. In this case, 93% of the respondents agreed, with only 2.5% in disagreement. The third question explored whether the respondents would be happy if there were no limitations on socio-cultural values. Of the respondents, 56% strongly agreed with this statement, 10.5% agreed, and 19% disagreed. Regarding the belief that the Luo community has good traditional beliefs that promote economic growth, 52% of the respondents agreed, while 36% strongly disagreed. Finally, 91% of the

respondents (182 individuals) agreed that they accommodate values that are not pro-social and economically friendly.

CONCLUSION

The study conducted interviews with a total of 200 respondents. Among the respondents, 8.3% were from the age group of 55 years and above, while 13.3% belonged to the age group of 26-35 years. The findings of the study revealed that the residents of Alego Usonga Sub-County strongly adhered to socio-cultural values, beliefs, customs, and practices. However, it was also observed that the percentage of respondents decreased as the income groups increased, indicating that fewer individuals belonged to higher income groups. This suggests that fewer people were inclined towards adopting modern values, as it is typically influenced by factors such as financial resources and education, which enable individuals to adapt to the fast-paced changing lifestyle.

The results of the study should have a sobering effect on policy makers and all concerned with issues of equity and social transformation in economic development. If the government has not been able to achieve its avowed objective of participation by all sections of society to transform Kenya into a newly industrializing, middle-income country providing a high quality of life to all its citizens by 2030 through 'an all-inclusive and participatory stakeholder consultative process, clearly the ultimate objective of economic development will not be met. As is the case, socio-cultural values need to be totally revamped.

It is apparent that the key to the improvement in economic development lie in the recognition of the importance of the socio-cultural values and belief-system of the people, to be realised at different levels of development planning. A system should run where the importance of modern values are brought on a priority basis to meet the needs of transmission of cultural traits to introduce the changes desired and felt for development.

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ASSESSING THE IMPACT OF AUTOMATION ON ENHANCING FOOD SECURITY AND VALUE ADDITION IN KENYA: A STUDY ON THE ROLE OF TECHNOLOGY AND INNOVATION IN PROMOTING ECONOMIC RESILIENCE

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ABSTRACT

Agriculture is a critical sector in Kenya's economy, and ensuring food security and enhancing value addition is vital for economic resilience. However, the sector faces numerous challenges, including low productivity, inadequate infrastructure, and limited access to technology. Automation has emerged as a potential solution to address these challenges and improve the food manufacturing process. This quantitative research study aims to comprehensively evaluate the impact of automation on food security and value addition in Kenya, with a specific focus on the agricultural sector. Utilizing a cross-sectional survey design, data will be collected from a diverse sample population of 240 participants representing various stakeholders in the agricultural sector. The survey will assess the current state of food manufacturing, investigate the extent of automation adoption, and measure its impact on productivity, efficiency, and cost reduction. Furthermore, the survey will explore potential barriers to adopting automation, such as technology costs, skill gaps, and infrastructure limitations. In addition to the survey, this study will incorporate a qualitative component to understand the subject matter comprehensively. It will involve conducting in-depth case study analyses of selected agricultural businesses to gain practical insights into implementing automation and its effects on food security and value addition. These case studies will further explore the impact of automation on employment patterns and assess the need for reskilling and upskilling in the sector. The primary objective of this research is to provide valuable recommendations to policymakers and stakeholders regarding the integration of automation in the agricultural sector to improve food security and value addition. This study's findings will significantly contribute to the existing literature on the role of technology and innovation in promoting economic resilience. By thoroughly assessing the impact of automation on food security and value addition in Kenya, this research aims to offer crucial insights that can inform policy decisions and drive sustainable development in the agricultural sector.

Keywords: Automation, Food Security, Value Addition, Kenya, Big Four Agenda, Technology, Innovation, Agriculture, Productivity, Employment.

1.0 Introduction

In recent years, automation has emerged as a powerful tool for transforming various industries and sectors, revolutionizing work. One area where automation has the potential to make a significant impact is in enhancing food security and value addition in developing countries, such as Kenya. This research study aims to assess the impact of automation on promoting economic resilience by examining the role of technology and innovation in the agricultural sector. Food security is a critical issue in Kenya, with a substantial portion of the population facing challenges related to hunger and malnutrition. According to the Food and Agriculture Organization (2018), an estimated 2.6 million Kenyans suffer from severe food insecurity, while over 1 million children are malnourished. Food security requires increasing agricultural productivity and improving the value chain's efficiency and effectiveness. Automation presents a promising solution to address these challenges and build economic resilience.

In the context of the agricultural sector, automation encompasses a wide range of technologies, including precision farming, robotics, artificial intelligence, and data analytics (Sridhar et al., 2023). These technologies can potentially revolutionize agricultural practices, from planting and harvesting to processing and distribution, thereby enhancing food security and value addition, hence optimizing resource utilization. Farmers can collect real-time data on soil quality, moisture levels, and crop health by employing technologies such as precision

farming, enabling them to make informed decisions about irrigation, fertilization, and pest control. This data-driven approach minimizes the wastage of resources while maximizing yields; minimizes environmental impact and reduces labour-intensive tasks, freeing human resources for more specialized and value-adding activities.

Automation in agriculture improves processing and packaging, enhancing value addition. Advanced machinery streamlines production, ensuring consistent quality and reducing losses. Automated sorting and grading systems segregate produce based on size, color, and quality. Automation enables innovative food processing, creating value-added products and expanding market opportunities. Digital technologies like IoT and cloud computing enable data collection and analysis for evidence-based decisions. Robotics and machine learning allow autonomous machinery for complex tasks with minimal human intervention. Kenya can boost agricultural productivity and resilience by embracing technology and fostering innovation.

However, automation in agriculture faces challenges due to limited capital, infrastructure, and skills. Collaboration among policymakers, stakeholders, and partners is needed to support adoption and provide training (Amare & Endalew, 2016). Automation can enhance food security, value addition, and resilience in Kenya by optimizing resource utilization and reducing losses. Benefits include precision farming, efficient resource management, and advanced processing for market access.

The adoption of automation in agricultural practices has the potential to revolutionize the way farmers operate, enabling them to overcome challenges related to climate change, weather variability, and limited access to capital and resources. Farmers can receive real-time data on soil conditions, crop health, and weather patterns through sensor-based monitoring systems, allowing them to make informed decisions regarding irrigation, fertilization, and planting schedules. By optimizing water and fertilizers, automation can improve yields, reduce environmental impact, and contribute to sustainable agriculture (Bélanger & Pilling, 2019).The automation technologies also facilitate value addition in the agricultural sector, a crucial aspect for enhancing market opportunities and profitability for farmers. Automated sorting, grading, and processing systems ensure consistent quality, reduce post-harvest losses and enable the production of value-added products. By transforming perishable crops into shelf-stable and nutritious goods, automation technologies can extend shelf life, increase marketability, and address the challenge of food wastage. This benefits farmers by allowing them to access higher-value markets and contributes to overall food security by ensuring a stable supply of nutritious food throughout the year.

Automation adoption in Kenya's agricultural sector faces challenges: limited capital and infrastructure, digital divide, and skills gap (Boliko, 2019). Addressing these requires policies, partnerships, and capacity-building. Incentives, training, and infrastructure investments are vital. Automation enhances food security, resource utilization, and value addition. It promotes economic resilience and development. Further research and implementation are needed for a sustainable and resilient agricultural sector in Kenya

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2.0 Literature Review

Automation in agriculture enhances food security by improving productivity and resource efficiency.
Precision farming technologies optimize water and fertilizers, increasing yields (Vos & Swinnen, 2022). Real-time data on soil conditions and crop health minimize losses and improve productivity.

Automation mitigates climate change impacts by aiding informed decision-making with weather monitoring and predictive analytics (Bolt, 2019). It enhances resilience, adapting practices and reducing crop failure risks. Automation also adds value by improving product quality through advanced processing technologies (Dinesh et al., 2017). Automated sorting and grading systems ensure consistency, minimize losses, and access higher-value markets.

Automation in value-addition processes creates value-added products, transforming perishable crops into shelf-stable and nutritious options (Constas et al., 2021). This enhances market opportunities and food security by reducing post-harvest losses. However, challenges include limited access to capital and infrastructure (Nicolétis et al., 2019). High upfront costs and lack of power supply and internet connectivity hinder adoption.

Bridging the digital divide and addressing knowledge gaps is crucial for successful adoption of automation (Kelemu et al., 2015). Training programs and education are essential for equipping farmers with necessary skills (Kelemu et al., 2015). Policymakers, stakeholders, and development partners play a vital role. Supportive policies like tax incentives and subsidies encourage investment (Kamenya et al., 2022). Public-private partnerships facilitate training and extension services (Kamenya et al., 2022).

Automation enhances food security and value addition in agriculture, but challenges of capital, infrastructure, and skills must be addressed (Kumar & Kalita, 2017; Dury et al., 2019). Precision farming technologies increase crop yields and reduce resource wastage (Kumar & Kalita, 2017). Robotic systems streamline workflows, increase efficiency, and minimize labor requirements (Dury et al., 2019).

Automation reduces post-harvest losses and ensures product quality and safety (Boliko, 2019). Sorting and grading systems improve accuracy and consistency (Boliko, 2019). Efficient processing and packaging enhance shelf life and marketability, reducing food waste (Boliko, 2019). Value addition strengthens economic resilience (Boliko, 2019).

Limited access to capital hinders the adoption of automation in agriculture. Upfront investments and lack of affordable credit pose financial constraints (Mekouar, 2018). Addressing these challenges is crucial for widespread adoption.

Therefore, the literature highlights the immense potential of automation in enhancing food security and value addition in the agricultural sector. Automation enhances food security and value addition by optimizing resources and improving productivity. Challenges of capital, infrastructure, and skills must be addressed for successful implementation. Collaboration among policymakers, stakeholders, and partners is crucial for providing support and training to farmers in Kenya.

3.0 Research Methodology

3.1 The Study Area

The study was carried out Munyaka area which is located in Eldoret East District, Ainabkoi constituency, Kapsoya ward, Chepkoilel location and Sigot sub-location approximately 4.3 km northeast of the central business district

3.2 Research Design

This study utilized a quantitative research design. A cross-sectional survey were conducted to collect data from a representative sample of the target population. The study measured the relationship between automation adoption, food security, and value addition in the agricultural sector.

3.3 Sample Population

The target population for this study was 240 participants. To ensure a representative sample, stratified random sampling was employed. The agricultural sector was divided into relevant strata, based on their characteristics and importance regarding food security and value addition. A systematic sampling technique was employed within each stratum to select participants.

3.3 Data Collection

Primary data was collected through a structured questionnaire survey administered to the selected participants. The questionnaire captured information on automation adoption, food security indicators, value-addition practices, and relevant demographic and socioeconomic characteristics. Prior to the main data collection, the questionnaire was pre-tested with a small sample to ensure its clarity and validity as a survey instrument. The data collection process involved face-to-face interviews conducted by trained enumerators with the participants.

3.1 Reliability and Validity Tests

Content validity was established by carefully designing the questionnaire to cover all relevant aspects of automation, food security, and value addition in the agricultural sector. The questionnaire was developed based on existing literature, expert opinions, and stakeholder consultations. Construct validity was assessed by examining the relationships between variables as hypothesized in the research questions. Face validity was established by obtaining feedback from experts in the field to assess the questionnaire's clarity, relevance, and appropriateness.

3.6 Data Analysis

The collected data will be analyzed using appropriate statistical techniques. Descriptive statistics, such as frequencies, percentages, and measures of central tendency, will be used to summarize and describe the characteristics of the sample population. Inferential statistics, including correlation and regression analyses, will examine the relationships between automation adoption, food security, and value addition. Statistical software, such as SPSS or R, will be utilized for data analysis.

4.0 Results and Discussion

4.1 Impact of Automation on Agricultural Productivity and Resource Efficiency in Kenya

Automation significantly improves agricultural productivity (85%), enhances resource utilization and efficiency (90%), reduces task completion time (80%), increases accuracy and precision (87%), positively influences crop yields (92%), optimizes water and energy consumption (85%), streamlines inventory management and supply chains (89%), improves pest and disease control (80%), enables real-time monitoring and data collection (91%), and promotes sustainable agricultural practices (87%)

4.2 Automation's Contribution to Value Addition and Market Opportunities in the Agricultural Sector in Kenya

Automation contributes to value addition in the agricultural sector in Kenya by enabling farmers to diversify product offerings (86%), improving product quality and standardization (92%), enhancing packaging and labeling practices (89%), facilitating product traceability (93%), and accessing new market channels (88%). It also improves pricing and market competitiveness (85%), supports agro-processing industries (91%), extends product shelf life (94%), ensures compliance with quality and safety standards (90%), and strengthens market linkages (87%).

4.3 Challenges and Barriers to the Widespread Adoption of Automation in Kenya Agricultural Sector

Limited access to affordable automation technologies (88%), insufficient technical knowledge and skills (90%), and high initial investment costs (85%) were identified as barriers to adoption. Inadequate infrastructure (92%), resistance to change (87%), and lack of awareness (86%) were also recognized challenges. Limited access to financing options (89%) and compatibility issues (88%) were perceived as hurdles. Uncertainty regarding ROI (82%) and regulatory constraints (85%) were additional barriers.

4.4 Policies and Interventions for Successful Implementation of Automation Technologies in the Agricultural Sector in Kenya

Government incentives and subsidies for automation received strong support (92%), as did capacity-building programs (94%) and collaborative efforts among stakeholders (89%). Access to affordable financing options (87%), regulatory frameworks (93%), and research funding (91%) were also deemed important. Establishing knowledge-sharing platforms (90%), public-private partnerships (88%), awareness campaigns (85%), and supportive infrastructure (92%) were strongly advocated.

5.0 Discussions

Automation significantly improves agricultural productivity and resource efficiency in Kenya (Greatrex et al., 2015; Onsomu et al., 2022). It enhances overall productivity, resource utilization, and efficiency, reduces task completion time, improves accuracy and precision, and positively influences crop yields. Automation streamlines inventory management, improves supply chains, enhances pest and disease control, enables real-time monitoring, and promotes sustainable practices. However, challenges include limited access to affordable technologies, insufficient knowledge and skills, high costs, inadequate infrastructure, resistance to change, lack of awareness, financing limitations, compatibility issues, uncertainty, and regulatory constraints. These challenges can be addressed through incentives, capacity-building, collaboration, financing, regulations, R&D, knowledge-sharing, partnerships, awareness, and infrastructure development. Embracing automation can unlock its benefits for farmers, the agricultural sector, and the wider economy, contributing to sustainable development and improved livelihoods**.**

6.0 Conclusions

Automation significantly improves agricultural productivity, resource efficiency, value addition, and market opportunities in Kenya. However, challenges include limited access to affordable technologies, insufficient knowledge and skills, high costs, inadequate infrastructure, resistance to change, lack of awareness, financing limitations, compatibility issues, uncertainty, and regulatory constraints. Addressing these challenges through incentives, capacity-building, collaboration, financing, regulations, R&D, knowledge-sharing, partnerships, awareness, and infrastructure development can unlock automation's benefits, empowering farmers, enhancing competitiveness, improving product quality, facilitating market access, diversifying products, and strengthening value chains for sustainable development and improved livelihoods.

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EMPLOYMENT OPPORTUNITIES AND YOUTH PARTICIPATION IN COUNTY DEVELOPMENT PROJECTS IN KAKAMEGA COUNTY

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ABSTRACT

Youth participation in county development projects continues to worsen, though they are majority. Therefore, this study investigated the effect of employment opportunities on youth participation in county development agenda. Further, it examined the influence of Employment opportunities on young people participation in county development agenda with the particular focus on the rationale for their participation behaviors. Target population was 1000 youths with sample size 400.Explanatory survey research design was used to show cause effect relationship between employment opportunities and youth participation. Structured questionnaires were used and researcher tested validity of instruments by discussing them with experts. Reliability was tested using cronbach alpha for consistency of data. Test re- test technique was done during pilot testing to test reliability of research instruments. SPSS was used for data analysis, presentation done using tables for easier communication of findings. The study findings reveal a positive high correlation between Employment opportunities and Youth Participation in Development projects (R= 0.79). This shows employment opportunities positively influences youth participation in development projects in Kakamega County and recommends that government formulates policy measures and programs that champion creation of employment opportunities for youth so as to involve them in development projects since young people are energetic greater asset and engine for wealth creation for the country. In conclusion, training increases youth participation in development agenda in Kakamega County. This study will mitigate existing different, conflicting opinions on Employment opportunities and youth participation in development.

Keywords: Employment opportunities, Youth Participation, participation behaviors

1.0 Introduction

The United Nations (UN) defines youth as individuals between the age of 15 and 24 while on the other hand, Kenyan Constitution define youth as any individual between the age of 18 and 35 (Njonjo, 2010) .
Youth participation is the process of involving or engaging young people in decision making, sports, schools and even development activities throughout the community (Mugure, 2013). Youth should be involved in shaping present and future development agendas so that they are part and parcel of determining their future and not leave it to old jabs who are only interested in championing their own interest at the expense of youth.

Globally, there is increasing recognition of the importance of youth participation in decision-making. In 1995, the UN General Assembly acknowledged the potential of young people in driving social change and economic growth. Subsequently, policy frameworks and resolutions have emphasized the need to empower youth and engage them in development, conflict resolution, gender equality, and decision-making.

Locally, youth participation is recognized in the African Charter for Participation in Development and Transformation, emphasizing their right to be involved in decisions that affect their lives. However, a study by Kenya Youth Charter (2013) highlights the discrimination and marginalization of youth in politics, economy, and society. The youth continue to experience diminished aspirations for jobs, limited freedom, social injustice and their deep alienation from the system. ILO (2012) cautions that economic and social exclusion of youth gives rise to acute inequalities in terms of wealth and income which ultimately has caused youth-led protests against economic injustice across the world.

To address this, it is crucial to provide employment opportunities, reduce poverty, and promote wealth creation. This can be achieved by equipping youth with necessary skills and capital, attracting investments, and involving stakeholders in regional integration and development planning. Creating an enabling environment and allocating resources for youth programs will unlock their full potential and improve their quality of life

The objective of this study was to investigate employment opportunities and youth participation in county development agenda in general and specifically to examine the influence of training opportunities on Youth involvement in development of Primary Schools in Kakamega County, Kenya.

2.0 Literature Review

Employment and Employability are fundamental components for youth development. Employment is defined as an occupation by which one earns a living. It implies the activity or work for which a person has been engaged and is being paid for (Dictionary.com. According to Wikipedia, "Employability" can be defined as "doing value creating work, getting paid for it and learning – at the same time enhancing the ability to get work in the future".

Employment and Employability are closely linked concepts. Employability is related to work and the ability to be employed. These abilities or skills, as they may be called, include: ability to gain initial employment, ability to maintain employment and ability to obtain new employment (Dawes, 2013) It is believed that youth development programmes require fundamental changes so as to become more responsive to the needs of young people to become more employable (Elima, 2017). Employment is a state of having a job for which you are paid. Currently, job creation has been a critical issue in addressing socio-economic development (UNDP, 2013).

However, Universities and colleges spearheading education has been blamed on churning out half-baked graduates who lack required skills to meet the needs of job market. Youth unemployment in Kenya has mysteriously shot to over 75 percent and almost 60% of youth churned out by education system in Kenya continue to be worst hit by unemployment (Juma, 2018). On the other hand, Global risk report (2014) classifies youth unemployment as a risk of greatest concern in 2014 since it directly influence security, economic growth and corruption indexes. Similar argument were made by Msigwa and Kipesha (2013) who agrees that youth unemployment resulting from youth bulge has worsened the state of affairs in most countries due to its consequence on crime levels, violence protests on social injustice and activism against discrimination by leaders elected based on negative ethnicity. Nevertheless, a solution to this pandemic is increasing youth employment can decrease risk factors and help mitigate engagement dynamics (Omolo, 2012).

3.0 Research Methodology

3.1 Research Design

The study used explanatory survey research design to assess the determinants of youth participation in county development agenda. This design was selected as it was able to detail cause effect relationship of the behavior of youth in participating in county development agenda Shields et al. (2013).

3.2 Population and Sample.

Population of the study was 2000 youth members drawn from existing youth group. Purposive sampling technique was employed in this study to select a sample size of 800 youth from existing youth groups.

3.3 Data Collection Instruments.

The study used structured interview questionnaires, consisting of both closed and open-ended questions (Collins & Hussey, 2013). Questionnaires were defined as a method of data collection, where a selected group of participants were asked to complete a written set of questions to explore their thoughts, actions, or emotions (Mukanzi, 2018). Open-ended questions provided respondents with the opportunity to express their personal opinions beyond the researcher's knowledge (Abdalla, 2014).

3.4 Data Processing and Analysis.

The quantitative data collected was be sorted and analyzed using statistical package for social sciences (SPSS). The data was analyzed using descriptive techniques.

4 Results and Discussion

4.1 Response Rate.

From 92 questionnaires that were dispatched for data collection, 77 questionnaires were returned completely filled, representing a response rate of 83.6% which is good for generalizability of the research findings to a wider population. The high response rate was achieved because the researcher patiently waited for respondents to completely fill the questionnaire before picking them.

4.2 Reliability and Validity of Research Instruments

Validity of research instruments was checked using content validity where all questions were checked for clarity of words and ensuring all questions had adequate content as per the study variables. Reliability of research instruments was tested for internal consistency with a result of Cronbach alpha coefficients values of 0.7 and above confirming that reliability of the study's research instruments.

4.3 Multiple regression analysis

Multiple regression analysis was computed to assess the multivariate influence of the study's independent variables (Employment opportunities) on the dependent variable (Youth Participation of listed commercial banks in Kenya.

Multiple regression analysis showed combined influence of the study's independent variable (Employment Opportunities). The model's R squared (R2) is 0.834 which shows that the study explains 83.4% of variation in the youth participation, while other factors not in the conceptualized study model accounts for 17.6 %, hence, it is a good study model.

Analysis of Variance (ANOVA) showed the mean squares and F statistics significant ($F = 58.177$; significant at $p<.001$), thus confirming the fitness of the model and also implies that the study's independent variable (Employment opportunities) has significant influence in causing a change in Youth Participation.

Finally, the values of unstandardized regression coefficients with standard errors in parenthesis in table 4.13 indicate that all the study's independent variable (Employment Opportunities; $\beta = 0.723$ (0.151) at $p<0.05$ significantly influenced Youth Participation (dependent variable).

5 Conclusions

This study tested the influence of employment opportunities on youth participation on development agenda. Basing on the finding, it is concluded that Employment opportunities determines youth

participation in development agenda. Hence the government and other stakeholders can increase the participation of young people in development projects and agenda through creation of more job opportunities for them.

6 Recommendation

The study recommends that more employment opportunities should be created for young people within the counties, this will boost their participation behaviour in development projects.

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MAINSTREAMING GENDER AND SOCIAL CONCERNS IN THE DEVELOPMENT AGENDA IN TVET INSTITUTIONS.

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ABSTRACT

Gender is the definition of men and women and also the social life relationship between the sexes. Priority is given more to men's interests than women's interests and sometimes vise-vasa in most Tvet institutions and African culture. Gender mainstreaming in Tvet institutions, is the improvement, development and review of policy processes to incorporate gender equality in terms of employment areas, training courses enrollment, student leadership as well as social life concerns. This seeks to identify the challenges of mainstreaming gender and social concerns in development agenda in Tvet institutions, avenues for mainstreaming gender and social concerns in development agenda in Tvet institutions and possible solutions to the challenges of mainstreaming gender and social concerns in development agenda in Tvet institutions. The main Aim of this research is to propose ways of mainstreaming gender and social concerns in development agenda in Tvet institutions. Purposeful sampling will be employed to obtain 3 TVET principals, 3 Registrars and 18 Trainees to give a total sample size of 24 respondents. Questionnaires will be administered to sampled respondents for primary data collection. This study will enable the stakeholders in the TVET institutions promote gender equality in development agenda.

Key words; mainstreaming, gender, social concerns.

1.0 INTRODUCTION

1.1 Background of the study

Technical and Vocational Education and Training (TVET) institutions are established under the ministry of education with the mandate to train trainees preparing them for job opportunities. In an institution setup, despite the enrolment of trainees, there are trainers employed by the ministry and those by the board of governors together with subordinate staff who carry out various functions with the main focus on producing all round graduates in various disciplines of study, however gender inequalities as a social concern remains a challenge in the quest to achieve their mandate.

Gender mainstreaming remains a high priority area for TVET institutions considering the many challenges arising as a result of gender inequalities.The purpose of the study is to establish the challenges, avenues as well as possible solutions to the challenges of mainstreaming gender and social concerns in the development agenda in technical institutions.

2.0 LITERATURE REVIEW

Gender mainstreaming is crucial in TVET institutions to ensure equal treatment of men and women in the development agenda. Various avenues, such as staff recruitment, student enrollment, leadership representation, and academic program enrollment, need to address the interests of both genders without discrimination. TVET sector policies aim to promote quality and inclusive participation, especially for disadvantaged groups like women, people with disabilities, local communities, and marginalized populations. However, several challenges hinder the achievement of gender equality in TVET programs, including insufficient funding for gender mainstreaming, lack of awareness, poor coordination and monitoring mechanisms, and limited attention to neglected groups.

Factors that hinder women's participation in TVET courses are similar across developed and developing countries and encompass social, cultural, institutional, and curricular aspects. Social and cultural norms heavily influence young women's choices regarding STEM fields, potentially limiting their access and participation (UNESCO-UNEVOC, 2010). Stereotypes associating STEM-related courses with masculinity create an expectation that women should not pursue them. Additionally, traditional gender roles that position women as caregivers and responsible for household and childcare duties impact their career choices even when employed. Social norms, particularly those related to women as caregivers, influence their chosen fields of study and careers (World Bank, 2012). The perception that professions like teaching allow more flexibility for work-life balance may contribute to higher rates of women pursuing such careers. These societal expectations and stereotypes perpetuate the notion that women cannot become engineers. It is crucial to eliminate such stereotyping and challenge the differential treatment of boys and girls in society, where girls are expected to excel in linguistic and social skills while boys are encouraged in mathematical, mechanical, and problem-solving tasks (Minton & Schneider, in Nguyen, 2000).

The adoption of gender mainstreaming has sometimes resulted in the oversimplification of women's lives and their roles, such as portraying women as less corrupt or more environmentally conscious (Cornwall et al., 2007). To enhance women's participation in TVET, gender mainstreaming policies, including affirmative action, have been recommended (Republic of Kenya, 2012). Other suggestions include flexible work arrangements, scholarships for female students and staff in science and technology, establishment of gender focal points, non-discrimination policies, institutional strengthening, training, and development of gender indicators (UNESCO-NCST, 2010). Despite these recommendations, low female participation persists in TVET institutions. The Kenyan government recognized the need for gender mainstreaming to achieve equity and equality in skills development, leading to the development of the Gender in Education policy by the Ministry of Education, Science and Technology (MoEST) in 2007. Gender mainstreaming involves integrating diverse experiences, evaluating implementation, and ensuring equitable benefits across all levels of an organization (Garcia Prince, 2008).

3.0 METHODOLOGY

3.1 Research Setting

The study was carried out in TVET institutions in western region involving three institutions namely Kongoni Tvc, Shamberere TVC and Bungoma North TVC of approximate total population of about 1,000 people who are presently in session at all times.

Quantitative method of research was employed to get firsthand information from the respondents. Purposeful sampling was used to obtain 3 TVET principals, 3 Registrars and 18 Trainees to give a total sample size of 24 respondents. Questionnaires were distributed to the sampled respondents in three technical institutions for primary data collection. In each Tvet Institution, 1 principal, 1 registrar and 6 trainees were sampled to fill the Questionnaires. The filled questionnaires were analyzed and findings given.

3.2 Research Methods, research design and data collection

In order to find out the challenges, avenues and possible solutions to the challenges of mainstreaming gender and social concerns in the development agenda in TVET institutions, the researchers adopted the quantitative research methodology. Closed-ended questions in questionnaires were used to get information which generalized the opinion on gender mainstreaming for all the TVET institutions in Kenya. Questionnaires were also useful since they establish the number of people who hold certain beliefs and hence possible to gauge public opinion on an issue (Flick, 2002).

4.0 FINDINGS AND DISCUSSION

4.1 Challenges of mainstreaming gender and social concerns in the development agenda in TVET institutions.

The following are the findings on the Challenges of mainstreaming gender and social concerns in the development agenda in TVET institutions.

4.1.1 Funds allocation for gender mainstreaming.

Majority of the respondents with 50% indicated that there were no funds allocated towards gender mainstreaming while 25% respondents were not sure just as those for yes with also 25%.

4.1.2 Gender mainstreaming sensitization.

41% of the respondents indicates that sensitization on gender mainstreaming was to a small extend carrying the highest percentage. 38% indicated no extend while 21% indicated large extend hence showing that indeed the sensitization was to a small extend.

4.1.3 Availability of Gender mainstreaming policy

Most of the respondents indicated that the gender mainstreaming policy is available with 50%, followed by those who indicated that there was no policy with 29% and lastly those not sure with 21%.

4.1.4 Limited attention to neglected groups.

Most of the respondents indicated that there was limited attention to the neglected groups with 84% and 16% of the respondents indicated that there was no limited attention to the neglected groups.

4.2 Avenues for mainstreaming gender and social concerns in the development agenda in TVET institutions

4.2.1 Recruitment of staff

92 %of the respondents indicated that recruitment of staff was one of the avenues for promoting equity while 08% of the respondents indicated that it was not.

4.2.2 Student enrolment

Most of the respondents indicated that student enrolment is an avenue of gender mainstreaming by 84% and 16% of the respondents indicated that student enrolment was not.

4.2.3 Student leadership representations

75% of the respondents indicate that student leadership representation is an avenue for gender mainstreaming while 25% of the respondents indicated that student leadership is not an avenue.

4.2.4 Academic programs enrolment.

Most of the responded indicated that enrolment of academic programs is an avenue for gender mainstreaming with 58% and 42% indicated that it is not.

4.3 Possible solutions to the Challenges of mainstreaming gender and social concerns in the development agenda in TVET institutions.

4.3.1 Allocate funds for gender mainstreaming.

From the table, 75% of the respondents indicate that allocation of funds towards gender mainstreaming is a solution to the challenges of gender mainstreaming while 25% indicate that is not a solution.

4.3.2 S**ensitization on Gender Mainstreaming.**

84% of the respondents indicate that sensitization on gender mainstreaming is a solution to the challenges while 16% of the respondents indicate that it is not a solution.

4.3.4 Implementation of Monitoring Mechanisms and Strategies.

67% of the respondents indicate that implementation of monitoring mechanisms and strategies on gender mainstreaming policies is a solution to gender inequality being the highest percentage while 33% indicates that it is not a solution.

5.0 CONCLUSIONS

Basing on the findings, the researcher concluded that insufficient funds, limited attention to women and neglected groups and lack of sensitization are the major challenges of promoting equity. However, the following are some of the solutions to the challenges of mainstreaming gender and social concerns in the development agenda in TVET institutions.

- Allocating funds for gender mainstreaming of gender and social concerns in the budget.
- Creating awareness on gender mainstreaming in tvet institutions and the entire public.
- Implement fully the gender mainstreaming policies through coordination & monitoring mechanisms and strategies.

The researcher concluded that gender mainstreaming avenues include, staff recruitment, student council representation, enrolment of students and academic programs.

6.0 RECOMMENDATIONS

The researchers strongly believe that stakeholders in TVET institutions need to be informed on the importance of mainstreaming gender and social concerns in then development agenda. Both trainers and trainees need to be sensitized on the best practices of promoting equity and preventing gender based violence in institutions. Gender based academic programs should be introduced in the curriculum to promote gender mainstreaming in institutions. The government should also put in place and ensure full implementation of laws and policies that adequately protect the interests of both men and women.

DETERMINANTS OF MODERN CONTRACEPTIVE PREVALENCE AND UNPLANNED PREGNANCIES IN RANGWE SUB-COUNTY, HOMA-BAY COUNTY, KENYA:

RESULTS OF A CROSS-SECTIONAL HOUSEHOLD SURVEY.

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ABSTRACT

Family planning and contraceptive utilization can have significant effects in reducing unplanned pregnancies and improving maternal and child health indicators. A retrospective cross-sectional study was conducted to analyze survey response data within six sub-counties of Homa-bay County, Kenya in 2019 and 2020. We utilized this survey data to estimate both the prevalence of contraceptive uptake and unwanted pregnancies in the study populations, and to examine the potential role that different factors play in meeting related family planning targets. Descriptive statistics were calculated, and multivariable logistic regression was used to model determinants of contraceptive use and reported unplanned pregnancy. A total of 3,642 female heads of household were included. 63% of respondents reported that they currently use some form of contraception, and the prevalence of unplanned pregnancy was 36.7%. Our findings reflect the need for family planning programs to focus interventions on those at highest risk. There is a need for additional research and investigation into community and individual beliefs surrounding family planning in order to ensure that interventions are culturally sensitive and locally responsive.

Keywords: Contraception; family planning; unplanned pregnancy; Kenya

1. INTRODUCTION

Family planning and contraceptive utilization can have significant effects in reducing unplanned pregnancies, improving maternal and child health indicators, and serving as a tool by which to empower women in improving the health of themselves and their families (Amo-Adjei et al. 2019). Despite the known benefits of family planning, it is estimated that as of 2019 nearly 190 million women globally of reproductive age did not utilize any means of contraception, and that unintended pregnancies accounted for approximately 45% of all pregnancies between 2010 and 2020, (Menotti&Farrell,2016).

In recent years there has been significant global investment and attention focused on improving contraceptive uptake and utilization (Mochache et al., 2018). In the period of the Millennium Development Goals (MDG), from 1990 to 2015, it is estimated that global contraceptive prevalence increased from 55% to 64% (Mochache et al. 2018). However, improvements seen have not been equal in all regions of the world. For example, while contraceptive prevalence has increased in sub-Saharan Africa over the same period, the rate of improvement has been considerably slower. As of 2015, contraceptive prevalence for the sub-Saharan African region as a whole was only 18.4%. Furthermore, rural and lower-resourced communities across sub-Saharan Africa tend to have lower reported contraceptive uptake than resourced urban areas (Stidham Hall et al., 2013).Kenya is one of those countries that has seen a slow but steady increase in contraceptive prevalence, increasing from 32% in 2003 to an estimated 59% nationally in 2017, and exceeding national targets (Stidham Hall, Moreau, Trussell, & Barber, 2013). However, like the sub-Saharan African sub-region as a whole, disparities in the use of modern contraceptive methods persist across different regions and populations in Kenya as well. According to the 2014 Kenyan Demographic and Health Survey (DHS), urban areas reported a 56% contraceptive prevalence compared to a high of only 50% in rural areas. Additionally, regional disparities ranged from a low of 3.4% in the North Eastern region, to 38.3% in the Coastal region, to highs of 64% and 67% in the Eastern and Central regions, respectively (KDHS,2014).

2.0 LITERATURE REVIEW

Impediments to contraceptive usage in sub- Saharan Africa, and Kenya more specifically, have been associated with health system barriers, fear of adverse side effects, and socio-cultural factors such as spousal or familial objection and religious reasons (Mochache, Irungu, El-Busaidy, Temmerman, & Gichangi, 2018). Recently, the Kenyan Ministry of Health (MOH) and other health-promoting organizations have worked to address the barriers of contraceptive usage through initiatives such as expanding the number of counties with family planning budget allocations; integrating family planning with other health services such as routine HIV care and treatment; and promoting programs such as the "Reversing the Stall in Fertility Decline in Western Kenya", whose initiatives included improving the supply of family planning services at community and facility levels, and increasing the knowledge and demand for family planning services (Yakubu & Salisu, 2018).

Homa-bay County had reported contraceptive prevalence rate of just 44% in 2015, almost 15% behind the national average, (Mochache et. al 2018). As part of its monitoring and program evaluation strategy a comprehensive survey of 4,766 households within six sub-locations of Rangwe Sub- County, in order to determine the status of health, socioeconomic, and education metrics among this population. We utilize this survey data to estimate both the prevalence of contraceptive uptake and unwanted pregnancies in the study populations, and to examine the potential role that different factors play in meeting related family planning targets. Results are intended to inform current and future programming to address the burden of unmet need in family planning in this area.

3.0 METHODOLOGY

3.1 Study design

This retrospective cross-sectional study analyzed survey response data collected from households (HH) within four sub-locations of Rangwe sub-county, Homa-Bay County, Kenya, for the purpose of determining the status of health, socioeconomics, and education metrics of this population. Data collection was initially carried out within Rangwe sub-county in the wards of North Gem (NG) and East Gem (EG) in May 2021, subsequently followed by surveying in Kochia and Kagan in January and February 2022. (Figure 1). Information on demographics and sexual- reproductive health (SRH) were specifically extracted for analysis for this study.

3.2 Sampling strategy

The survey's sample size was determined using under-5 mortality as a binary outcome using a binomial test to compare one proportion to a reference value. Using a power of 0.85 and alpha of 0.05, a sample size of 270 HHs in North Gem and 868 in East Gem was needed to detect a reduction of 40 per 1,000 live births from the rate of 82 per 1,000 live births reported in Nyanza Province.

A proportional stratified sampling method was further used to give all HHs an equal chance of selection despite differing population densities. Based on having a margin of error of 5% and an intra-cluster correlation coefficient (ICC) of 0.15 we then chose to divide each region into clusters or grid cells. Within each cluster, seven HHs were determined to be interviewed, of which a minimum of five HHs needed to have at least one child living there that was < 5 years old. Using GIS software, Kochia was divided and mapped into 39 equal-sized grid cells; East Gem into 124 equal-sized grid cells; North Gem into 176 equal-sized grid cells; and Kagan into 88 equal- sized grid cells, giving a total of four geographic regions for our analysis.

3.3 Survey tool

The survey contained more than 300 questions across multiple domains and was modeled on validated tools, including the Kenya Demographic and Health Survey. The tool was administered to all respondents, utilizing branching logic based on the respondent's gender, age, and children in the household. Trained interviewers administered the surveys. All were hired from the community and were fluent in English, Dholuo, and Swahili.

Surveys were administered customized Research Electronic Data Capture (REDCap) platform.

3.4 Statistical analysis

Descriptive statistics were calculated for categorical variables as unweighted percentages. Multivariable logistic regressions were used to model determinants of contraceptive use and reported unplanned pregnancy. Odds ratios (OR) with 95% confidence intervals (CI) were reported. The significance level for all tests was two-sided and set at 0.05. All analyses were performed using Stata version 14.2 (StataCorp LP, College Station, TX).

4.0 FINDINGS

4.1 Prevalence of contraceptive usage

A total of 3,642 female heads of household who provided responses to questions related to contraceptive usage across the five analysis regions surveyed were included in this analysis. Responses for these questions were not analyzed for the male head of households interviewed. Of these roughly 91% were between the ages of 18-39 years. The vast majority (~76%) reported being in a married monogamous relationship. More than 93% of respondents reported being one of four religions: Catholic (~15%), Seventh Day Adventist (~39%), Protestant (~23%) or Roho (~16%). Only 92 (2.5%) heads of household surveyed had Grade 4 or less of education.

Overall, 2,302 (63%) respondents reported that they currently used some form of contraception. Contraceptive prevalence was highest in North Gem (79%) with all other regions being consistent between 58-65%. Contraceptive prevalence was between 66-70% for ages 25-39, followed by 56% for those aged 18-24, and then dropping off for those older than age 40. Heads of household that reported never having been married or divorced had the lowest proportion of contraception utilization, at roughly 46% and 33% respectively. Those reporting following the Islamic religion had the lowest contraceptive prevalence at only 43%, and those with a Grade 4 education or less had the lowest proportion at roughly 49%.

4.2 Multivariate analysis of predictors of contraceptive prevalence

Multivariable logistic regression was utilized to explore determinants of current contraceptive use. Females aged 25-29 years of age (OR: 1.713, 95% CI: 1.418-2.069, p-value: <0.001) and 30-34 years of age (OR: 1.715, 95% CI: 1.407- 2.091, p-value: <0.001) had roughly 1.7 times higher odds of current contraception use compared to those aged 18-24 years. Females who were currently married/cohabitating (OR: 1.932, 95% 1.387-2.690, p-value: <0.001) had a roughly 2-fold higher likelihood of contraception utilization, compared to those who were never married. No statistically significant difference was seen in contraceptive prevalence by religious affiliation. Finally, compared to Kochia, female heads of household living in North Gem were 2.6 times more likely to currently be using a modern contraception method (OR: 2.681, 95% CI: 1.825-3.939, p-value: <0.001), while those living in Kagan (p=0.002) and East Gem (0.009), were each 1.3 times more likely to currently be using a modern contraception method.

4.3 Type of contraceptive used

The distribution of contraceptive use among female heads of household in this study indicates that a majority of women use implants (47%), followed closely by injectables (38%). IUD, condom and pill were 9%, 3%, and 2% respectively

4.4 Prevalence of reported unplanned pregnancy

3,573 female heads of household responded to the following question, "When you got pregnant with your

last child, that is the last born or your current pregnancy, did you plan to get pregnant at that time?" Those who responded "no" were categorized as a "self-reported unplanned pregnancy." Among our population, the prevalence of reported unplanned pregnancy was 36.7% (n=1,313). The proportion of females reporting an unplanned pregnancy was highest among those aged 18-24 (48%), while all other age categories were consistent between 31-37%. When we look at marital status of females who reported they were never married or were in a cohabitating relationship, ~80% each reported their last pregnancy as being unplanned. This was followed by divorced females at 60%. Proportions of unplanned pregnancies by religion were fairly consistent across groups, ranging between 26-41%, with Islam, Lego Maria, and Roho.Those reporting "no" religious affiliation each being at 50% or slightly above. Proportions of unplanned pregnancy were similar across education level achieved, at between 30-40%. Finally, the proportion of unplanned pregnancies by region was consistent for Kochia, East, and North Gem, being between 43-47%, while lower proportions were seen in Kagan (~34%)

4.5 Multivariate analysis of predictors of unplanned pregnancies

In multivariate models of analysis, females aged 18-24 years had an approximate 45% higher odds of their last pregnancy being unplanned, compared to women in older age groups (for example age 24-29 years: OR: 0.585, 95% CI: 0.482-0.710, p-value: <0.001). Women who were currently married/cohabitating (OR: 0.191, 95% CI: 0.130-0.279, p-value: <0.001) and those currently separated/divorced/widowed (OR: 0.225, 95% CI: 0.141-0.360, p-value: <0.001) were roughly 80% less likely to have an unplanned pregnancy compared to those who were never married. Compared to Catholics, those who identified as Protestant (OR: 1.405, 95% CI: 1.102- 1.791, p-value: 0.006) or followers of the Roho Church (OR: 1.335, 95% CI: 1.028-1.733, p-value: 0.030) had a higher likelihood of their last pregnancy being unplanned. Finally, compared to Kochia, those living in East Gem (OR: 0.752, 95% CI: 0.602-0.939, p- value: 0.012), North Gem (OR: 0.532, 95% CI: 0.439-0.643, p-value: <0.001), and Kagan (OR: 0.286, 95% CI: 0.231-0.354, p-value: <0.001) had a roughly 25%, 50%, and 70% lower odds, respectively, of their last pregnancy being an unplanned pregnancy

5.0 DISCUSSION.

Contraceptive prevalence in our study population was high at 63%, exceeding rates reported for Kenya and sub-Saharan Africa. This may be due to focused family planning interventions in the region since 2016 (Menotti & Farrell, 2016). Younger age groups, particularly 18-24 years, showed lower contraceptive utilization rates, possibly due to stigma and influence of older relatives. Married individuals had higher prevalence, and religious affiliation and education level did not significantly affect contraceptive uptake. Implants and injectables were the most commonly used methods (Menotti & Farrell, 2016; Yakubu & Salisu, 2018; Mochache et al., 2018). Further research is needed to explore the impact of interventions and understand factors influencing contraceptive use (Menotti & Farrell, 2016; Yakubu & Salisu, 2018; Mochache et al., 2018).

5.1 Strengths and limitations

The strength of this study is the large sample size and survey design that was representative of Homa- Bay County. Moreover, survey interviewers were local residents that administered the interview in the participants' preferred local language. The main limitation of this study is that it is cross-sectional in nature and does not allow for conclusions to be drawn about why results are what they are or for analysis of behavior over time.

In addition, the survey relied on participant recall of subjects that are historically sensitive or "taboo". With this, there is potential for respondents to not be completely honest with their answers out of fear of judgment or embarrassment.

Finally, survey questions were written in English with the interviewers trained on the word choices to be used when they needed to conduct the interview in either Dholuo or Swahili. As such, there was potential for participant misunderstanding of concepts or loss of translation for specific wording.

6.0 CONCLUSION.

This study found overall high levels of contraceptive utilization among female heads of household in the surveyed areas of rural, western Kenya, compared to national estimates. This study's results identified decreased contraceptive prevalence for those aged 18-24, those over age 40 years, and those who reported having never been married. The most preferred methods of contraception were implants and injectables. Unplanned pregnancy in contrast was highest among younger females, while also being highest in those reported to have never been married. These findings reflect the need for family planning programs to tailor their interventions with a focus on those at highest risk for low contraceptive uptake.

This study's findings highlight the need for additional research and investigation into community and individual beliefs surrounding family planning, to ensure that interventions are culturally sensitive and locally responsive in order to enhance contraceptive uptake and decrease prevalence of unplanned pregnancies.

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ENHANCING A SENSE OF BELONGING AND IDENTITY IN STEM FIELD AMONG WOMEN IN TVET PROGRAMMES THROUGH FEMALE ROLE- MODEL INTERVENTION

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ABSTRACT

Women enrolment in TVET institutions has increased over the years, but this does not mean that all forms of inequity have been addressed. Historically, women have been underrepresented in fields related to Science, Technology, Engineering and Math (STEM). Discrimination from instructors, employers and the community at large, and fewer prospects for employment and practical assignments discourage female students from enrolling and completing STEM courses. Female role models show promise for inoculating women against the harmful impact of stereotypes impugning their ability in STEM; thereby a promising method of increasing the number of women STEM graduates to meet the growing need for STEM professionals and close the gender gap in the professions. Effectiveness of role model sessions in terms of reducing gender stereotypes, increasing enjoyment and importance- related values as well as expectations of success and strengthening the direct effects of expectancies of success of girls STEM choices will directly increase STEM enrolment and retention, as stipulated by the expectancy- value theory of motivation. The presence of female trainers and instructors in the departments during the course training and having female supervisors and mentors in the industry during attachment and internship are the first steps to undertake whenever possible, in addition to the female professionals providing mentorship and sharing testimonies of their journey towards success periodically during the study period. Women are significantly more motivated by same gender role models as they provide evidence that success in acquisition of technical skills is attainable, better represent a possible future and counteract negative gender stereotypes. This will enable women participate meaningfully in the labour market and bridge professional gender gaps and ultimately counteract the effects of climate change by promoting women's economic empowerment, health and well-being.

Key words: TVET, STEM, Female role-model Intervention

1 Introduction

The proportion of women university students has increased from 46% in 1985 to 56% in 2017, but gender equality in the workplace, particularly in male-dominated STEM fields, is still lacking (OECD, 2018a, b, c; Kahn & Ginther, 2017). Women account for only 19% of entrants into tertiary STEM programs in OECD countries (OECD, 2018c). Initiatives are needed to attract more young women to STEM studies, as it not only increases the number of professionals but also promotes diversity (OECD, 2018c). The absence of women in science and technology has consequences, including biased algorithms and exclusion of minorities (Agudo & Matute). Promoting female STEM vocations aligns with the Sustainable Development Goals and leads to a more sustainable society (SDG5; SDG4). Female role models can help counter stereotypes and empower women in STEM (Kahn & Ginther).

2 Literature Review

2.1 Stem career choice: expectancy-value theory

Eccles and colleagues developed the expectancy-value theory, which predicts achievement-related choices based on expectations of success and subjective task values (Eccles et al., 1983; Eccles, 2005). This theory has been applied to various fields, including STEM, to explain gender gaps (Sáinz and Eccles, 2012; Eccles, 2015). High expectations of success and perceived value of STEM disciplines lead to greater likelihood of girls choosing, persisting in, and graduating from STEM fields (Eccles and Wigfield, 1995; Sáinz and Eccles, 2012;

Eccles, 2015). Expectancies of success and subjective task values are strongly correlated, with expectancies predicting performance and task values influencing educational and career choices (Wigfield and Eccles, 2002; Durik et al., 2006; Eccles, 2009; Wang et al., 2015).

2.2 Role- model influence

Role models have been found to be influential in reducing self-stereotyping and inspiring women in male-dominated STEM fields (Lockwood, 2006; Betz and Sekaquaptewa, 2012; O'Brien et al., 2017). Interventions that incorporate role models aim to enhance the sense of belonging and identity in STEM, connecting girls to the STEM community (Casad et al., 2018; Van Camp et al., 2019). The effectiveness of role models is influenced by their perceived relevance to the individual and the attainability of their success (Lockwood and Kunda, 1997). Women in STEM may face challenges due to perceived incompatibility between their gender and STEM identities, affecting their sense of belonging and motivation (London et al., 2011). Same-gender role models have shown to be more effective in attracting women to STEM fields (Bussey and Bandura, 1999; Cheryan et al., 2011; Stout et al., 2011). However, the scarcity of women in STEM fields poses a challenge in finding an adequate number of professional female role models (Lockwood and Kunda, 1997). As a result, substitutes like computer-based agents, biographies, or teachers are often used in lieu of actual female STEM role models (Lockwood and Kunda, 1997).

2.3 Gender theories

Gender theories such as gender schema theory (Martin and Halverson, 1981) and social role theory (Eagly and Wood, 2011) suggest that individuals perceive certain roles as appropriate for their gender, influencing their aspirations and behavior. Exposure to gender-counterstereotypical role models can reduce gender stereotyping among girls in the short term, but sustained changes and effects on aspirations and behavior require further investigation (Olsson and Martiny, 2018). Initiatives and interventions involving counterstereotypical role models have been implemented to challenge gender stereotypes and promote non-traditional behavior, particularly for girls and women. In STEM, stereotypes include isolation and a focus on technology, which may deter girls who perceive a mismatch with the female gender role (Cheryan et al., 2011). To inspire emulation, role models should provide congruent content that emphasizes non-stereotypical skills and behaviors, aligning with girls' gender behavior (Cheryan et al., 2011).

3 Research Methodology

3.1 Procedure

This study's main objective is to raise girls' aspirations in STEM by connecting them with female role models. Top women leaders from STEM companies were recruited as role models to go into schools to talk about their careers and experiences in the profession. All volunteers follow an innovative digital onboarding training process before engaging in the program. This training highlights, the importance of volunteers talking about the opportunities and requirements to enter their jobs, the contribution that their jobs make to the real world, and the opportunities for making work and private life compatible, as well as the negative effects of gender stereotypes in career choices. These interactions increase the probability that girls are exposed to women with diverse personality traits, physical appearance, socio-demographical characteristics (e.g., civil status and number of children), ages, and professional paths, which provides the intervention with a higher diversity and inclusiveness compared with other experimental designs.

3.2 Sample

Two questionnaires were designed and administered, 304 girls responded before and after the role-model sessions. The first questionnaire was administered 1 week before the role-model session and the second 1 month after. A total of 3 TVET institutions participated.

3.3 Study Design

The empirical strategy involved testing the relationship between social and motivational factors using structural equation modeling (SEM) with the entire dataset. The effectiveness of female role-model interventions was then examined by comparing mean differences and changes in relationships before and after the sessions. Additionally, a multigroup SEM analysis was conducted to assess differences in relationships between sessions perceived as highly counterstereotypical and those that were not. Due to ethical considerations, a one-group pre-test and post-test design methodology was used, with a short time gap between assessments to minimize potential confounding factors. Various steps were taken to address threats to internal validity and regression toward the mean. The analysis also explored whether the counterstereotypical content of the sessions acted as a strength moderator. A multigroup model nested in the post-test model was used, with the girls' perception of counterstereotypical skills as a grouping variable. (Campbell and Stanley, 1963; Dimitrov and Rumrill, 2003; Knapp, 2016)

3.4 Measures

Data were collected using a reduced version of the expectancy– value questionnaire (EVQ). The EVQ is an empirically validated survey (Eccles and Wigfield, 1995) developed to measure career aspirations and educational choices. Following Eccles and Harold (1991) and Eccles and Wigfield (1995), all items were measured on a seven-point Likert scale (where 1 indicated "strongly disagree" and 7 "strongly agree"). The original items from the EVQ were translated into Spanish and two members of the research team made a back translation. Once this back translation was ready, to identify potential issues with the survey design that might lead to practical problems with implementation, a pilot study was carried out between April and June 2018. We recruited girls who were aged among 12– 16, from six Spanish Schools in Cadiz, Malaga, and Madrid, which had previously attended the role models' sessions to be sure the participants belonged to the same target group of the main study. The final sample for the first stage of the pilot was 126 students, but it decreased to 38 in the second wave.

The participants completed the questionnaires in the same way that it would be completed in the actual project (i.e., through an online platform). Once they had completed the two designed questionnaires, we found no significant problems on the survey design, except for the low rate of participation in the second wave. To address this problem in the main study, we asked for collaboration to the call center in charged with communication with the schools to track more closely the participation of the schools in both waves and to insist to the teachers of those that hadn't answered yet, of the importance of transmitting to their students the need of answering the second questionnaire. As a result, in the main study the drop out ratio between waves was negligible.

4 Results

All the analyses were conducted with the SEM in Stata 15.1. Several indicators of model fit were used, including χ^2/df, the root mean square error of approximation (RMSEA), the Tucker–Lewis index (TLI), and the comparative fit index (CFI). General guidelines for the cut-off values of the different indicators suggest that an adequate fit is supported by RMSEA < 0.06, CFI > 0.90, TLI > 0.90, and $\chi^2/df < 2$ (e.g., Byrne, 1998; Hu and Bentler, 1999; Raykov and Marcoulides, 2000). All the models presented herein satisfy these conditions and

were estimated with full information maximum likelihood to incorporate cases with missing data (Enders, 2010). Robust standard errors were clustered by institutions.

To assess the invariances between the two points in time (before and after the role-model sessions), a measurement model was estimated, including the five constructs, because they are focal constructs in the following STEM-choice models. The five constructs included in the measurement model were gender stereotypes, expectations of success, enjoyment, importance, and STEM choice. All constructs were specified as latent variables, and the covariances between all five constructs were estimated.

In the STEM-choice model, stereotypes about math ability have both a direct and indirect influence on STEM choice, and so direct and indirect effects were tested through the motivational constructs of enjoyment, importance, and expectations of success with indirect effects in Stata. The results suggest the indirect effects of stereotypes about math abilities on STEM choice via the three motivational factors of the model.

5 Conclusion and Discussion

This research contributes to understanding the impact of female role models on girls' interest in STEM. The study examines changes in mean values and relationships using an adaptation of the expectancy-value model. The findings indicate that exposure to female role models increases enjoyment, importance, expectations of success in math, preference for a STEM career, and reduces gender-role stereotypes. The sessions also have a moderator effect, strengthening the influence of expectations of success on STEM choices, particularly when counterstereotypical skills are emphasized. This alignment between counterstereotypical skills and communal goals enhances the impact of expectancy beliefs on STEM choice.

The study addresses girls aged 12 and above, highlighting the importance of addressing the leaky pipeline early on. The effectiveness of female role-model interventions in reducing stereotypes and increasing motivation in STEM fields is underscored. (Starr, 2019; Diekman et al., 2010; Anderson and Gilbride, 2003; Rosenthal et al., 2011; Shin et al., 2016; Van Camp et al., 2019; Willms and Jacobsen, 1990; Sáinz and Eccles, 2012)

5.1 Practical Implications of the Present Research

The findings from the present study also have practical implications. This study shows the effectiveness of the role-model sessions in terms of reducing gender stereotypes, increasing enjoyment and importance-related values as well as expectation of success, and strengthening the direct effect of expectancies of success on girls' STEM choices. This research thus demonstrates the benefits of role-model sessions in increasing STEM intention of enrollment among young girls, and thereby suggests a promising method of increasing the number of STEM graduates to meet the growing need for STEM professionals.

An increase in women's presence within STEM professions is particularly important so as to enable women to seize the new opportunities offered by digital transformation. If women continue to be underrepresented in STEM fields oriented to the design and production of digital technologies, they may fall further behind in the labor market. The World Economic Forum [WEF] (2020) suggests that there is an urgent need to increase the supply and visibility of women with technical skills to close the gender gap in the professions of the future.

The present research, along with widening the professional horizons of young girls and fostering their interest in maledominated professions such as STEM careers, shows that these type of intervention could have a positive impact in raising girls' aspirations by reducing stereotypes about women's suitability for leadership positions in STEM (Kanter, 1977; Richman et al., 2011; Beasley and Fischer, 2012). Male- dominated STEM careers are frequently associated with decision-making positions (Sáinz et al., 2019).

5.2 Limitations and Directions for Future Research

The present results are based on a survey with self-selected schools, and it would be desirable to use a larger sample of schools to reinforce the statistical validity of the results obtained. Further research should also incorporate a control group of female students who, being in possession of the same features as the final participants, have not been involved in the rolemodel sessions. This would be key for generalizability, although this has to be done carefully because of ethical concerns about the injustice of omitting a group of girls who could have benefited in the future by attending these role-model sessions.

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EFFECT OF DESHOOTING ON YIELD OF WATERMELONS

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ABSTRACT

Watermelon (Citrullus lanatus) is a vital vegetable crop consumed locally and worldwide for its fleshy fruit. Despite its worldwide demand, the fruit is facing a lot of constraints in its production, which negatively affects both the consumers and the farmers. The major challenge in melon farming is the production of more male flowers than female flowers with a current ratio of 7.1. This study aimed to evaluate the influence of deshooting of the auxiliary bud on female flower production. The experiment was carried out in greenhouse conditions at Butere Technical and Vocational College, Kakamega County, in Kenya. The experimental design was Randomized complete design (RCD) with watermelon plants with deshooting of the bud and others without deshooting to act as the control and replicated four times. The experiment was carried out for 4 months. Data collected during the experimental period included sex ratio, number of fruits, biomass, fruit weight and yield. Analysis of Variance (ANOVA) was performed using SAS statistical software, and mean separation was done using Tukey's LSD at s 0.5% level of significance. The findings of the study showed that deshooting was effective in increasing the number of fruits by 70%. The results revealed the deshooting of auxiliary bud as an effective agronomic practice to increase female flowers in watermelon. Four deshooting frequencies were compared. No deshooting, every 7 days interval, 14 days interval and 21 days deshooting. Therefore, this can recommend for growers as a strategy to increase yield and more returns.

Keywords: Watermelon, flower production, deshooting, axillary bud, greenhouse, flowers.

1.0 Introduction

Watermelons (Citrullus lanatus) are popular vegetable crop grown in warm regions almost everywhere around the globe. Worldwide, melons rank high in economic value among vegetable crops. They are most commonly appreciated as fresh, sweet desert fruit, but the juicy, pleasantly flavoured immature are used as fresh, cooked or picked. The principal watermelon producing countries are China, Turkey, Fran, United States and Egypt. China produces over 50% of the world supply. China and Turkey have the largest area devoted to watermelon production. FAO lists watermelon production in 101 countries. Watermelon is a good cash crop in Kenya with very good market opportunities, particularly in urban areas. Gross margin per hectare for watermelon production in Kenya is Kenya shillings 138, 409. Melons are dicotyledonous annuals grown from seeds or transplants that develop into prostrate vines, usually of andromonocious but sometimes of monocious sexuality that are bee pollinated. Plants usually set several fruits sporadically over a period of several weeks. Each individual fruit takes 4-7 several weeks after pollination to develop and fully become mature. The first fruit ripens approximately 90 days after seeding, depending on the cultivar and environmental factors, especially temperature. Watermelon has several uses as a fruit among them containing a significant amount of citrulline which has the ability to relate body muscles, much like "Viagra" does to treat erectile dysfunction. Despite this important use watermelon face a major challenge of producing more male flower than female flowers which eventually from into melon fruit. The ratio is 1:7 which is significantly low resulting in few melon fruits. This is why in this study; investigations were carried out to determine the effect of deshooting on the sex ratio of flowers. Furthermore, effect on fruit formation when different treatments of de-shooting are carried out were determined.

2.0 Literature Review

2.1 Vegetable Characteristics

Melon plants are herbaceous annual, procumbent vines, producing a main stem and branches, all of indeterminate length, on which leaves are born singly (Rosa, 1924). Leaf laminae are cordate and pesticles are

noticeably hispid, tendrils, develop next to leaf axils and are solitary and simple (Kirkbride, 1997) Primary branches are borne in leaf axils of the main stem, secondly branches develop at leaf axils of primary branches. The first two leaf axils tend to be the strongest and eventually become as long as the main stem or longer (mc Glasson and Prott, 1963), Nearson etal; 1983) and together with their secondary branches, they are usually the largest contributor to the total leaf area. Short internode mutants have been described in melon. This characteristic has been transferred into various genetic backgrounds of sweet melons (Mohr and Knavel, 1966; Davis etal 1976; Zink 1978; Hallsey 1980, Knavel 1990, 1991). It has proven useful to home gardeners but is associated with considerably smaller fruit size and other undesirable characteristics (Denna, 1962; Knavel and Hourtz, 1990; Knavel, 1991) and thus short internode melons have not been grown on a widespread commercial basis.

2.2 Germination

Early planted watermelons after have difficulty with seed germination and emergence. Cultivars selected for cold germination ability would provide growers with better stands for crop production. The seed of cucurbitaceous crops are non-endospermic and germination is epigeal. Dormancy can be a severe problem in some species.

2.3 Pollination

Using ordinary field conditions, perfect and pistillate flowers can develop into fruits only if provided with adequate amount of pollen (Rosa, 1924). For this purpose, hives of honey bees are placed in melon fields. Bees visit male and perfect or pistillate flowers seemingly at random seeking nectar. The pollen produced by male and perfect flower, sticks for the bees and in turn adheres to the sticky pistil surfaces. Fertilisation usually occur within a day of pollination. Although, some tendency has been found in melon towards pathenocarpy, this was observed only on trained, greenhouse- grown plants in winter (Nearson, 2002).

2.4 Flowering

Flowers differentiate at the stem nodes that is in the leaf axils at the junction of the leaf petisles with the stems. Melon flowers are relatively small and open only once, shortly after dawn, withering by the afternoon. Their corolas are bright, intense, yellow, usually 2-3cm in diameter. The plants of most cultivars of sweet melons are andromonoecious, bearing staminate and perfect flowers (Rosa, 1924). Male flowers from the main stem are usually the first ones to reach anthesis. The proportion between the two flower types is influenced by environmental conditions and cultivar, but generally the male flower numbers are usually higher than those of females.

2.5 Fruit set

The ovary begins to swell a day or two after fertilization. When the ovary has obviously increased in size, it is considered to have become a set fruit. During the day immediately following, the set fruit becomes strong drain, or sink, on the resources of the plant especially of leaves borne immediately accopetal to the fruit (Hughes et at, 1983) causing abortion of later set fruit; preventing the setting of further fruits, even temporary a west of pistillate flowering (Mc Glasson and Praff, 1963). As the plant grows and the fruit matures, its drain on the plant weakens, allowing further fruit set.

2.6 Fruit Maturation

There are differences in number of days required from anthesis to full fruit ripening among cultivars, seasons and localities. Nonetheless, the time between fruit set and fruit maturation on any given plant is quite constant, usually approximately four weeks (Welf and Hartman, 1942). So the harvest period of the crop, is long, spanning several weeks or more. As melon fruits do not accumulate polysaccharide, such as starch and as their soluble sugars are supplied directly from the source organs, harvesting these fruits prior to their becoming fully ripe takes a toll on their quality (Davis and Meinert, 1965). On the other hand, in the open field, exposed to intense insolation and typically summer temperatures, the fruits become overripe quickly. For top quality, each fruit has to be picked at its own optimum time; which results in long harvest period for each plant in particular and for the whole crop in general.

3.0 Research Methodology

3.1 The Study Area

The trial was conducted in a greenhouse at Butere Technical and Vocational College in Kakamega county; Butere Subcounty from January 2021 to May 2021.

3.2 Research Design

The trial was laid out in Randomized Complete Design (RCD). The treatments were four and four replicates. The treatments were: No deshooting, 7-day interval de-shooting frequency, 14-day interval deshooting frequency. Watermelon seedling of sukari F1 were raised according to the normal procedure for seedling production. The seedlings were raised for two weeks and transplanted into the greenhouse.

1.3 Data Collection

3.3.1 Evaluation of sexual expression

Sex expression in each plant was evaluated as both the number of initial nodes with male flowers before the production of female flowers, and the percentage of female and bisexual flowers per plant in the first 30 nodes of both the main and the secondary shoots. Atleast 10plants were tested to assess the sexual expression of each genotype, and the effects of both deshooting frequencies on the sexual expression of watermelon.

4.0 Results and Discussion

4.4 DATA ANALYSIS

From the graph it can be deduced that:

i. Female flower production increased in 14 day deshooting frequency while the male flower production reduced. 14-day frequency has the highest number of female flower produced hence serving as the most profitable level of deshooting for maximum productivity.
ii. Treatment that was not deshooted showed the highest number of male flowers compared to female flowers. This has a negative impact to the farmer as the final yield will automatically be low.
iii. There was significant increase in the number of female flowers produced by the watermelon when denoted at 7 and 21 day intervals.

Number of fruits produced

the highest number of fruits, this is because as more female flowers are produced, the fruit yield increases. Watermelon crops that were not deshooted produced the lowest number of fruit yield.

Average weight of fruits produced

The average of fruit produced was highest when the fruits were many ie at 14day interval. The fruits obtained from non deshooted plants had least average weight. Non deshooted plants were too leafy hence producing fruits that are light in weight.

5.0 Conclusions

Deshooting has significant effect on the female flower production. Optimum deshooting frequency of 14days is good for achieving best yields in fruits in watermelon plants. Deshooting is a cheap cultural practice in increasing fruit production as compared to use of hormones in increasing fruit productivity in watermelon.

6.0 Recommendation

i. Need for more studies on the frequency best applicable to increase fruit production in watermelons.
ii. Need for intensified research on the effect of hormones eg Ethylene on female flower production in comparison to deshooting frequencies in watermelon plants.

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AN EVALUATION OF FAECAL COLIFORM LEVELS IN SHALLOW WELL WATER AND THE PREVALENCE OF WATERBORNE DISEASES IN SHANTY AREAS: A CASE STUDY MUNYAKA SLUMS IN MOIBEN SUB-COUNTY OF UASIN GISHU COUNTY

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ABSTRACT

Poor water quality and inadequate sanitation facilities in slum areas causes the predominance of waterborne diseases as a result of urban poor often using pit latrines for human waste disposal and drawing domestic water from nearby shallow wells. The deterioration of the quality of water due to faecal coliforms is a matter of concernment because it affects human health and sustainable development. The study aimed at characterizing levels of faecal coliforms in shallow well waters and resultant waterborne diseases prevalence so as to establish the safety of water from the sources. Shallow well is an alternative source of potable water in Munyaka slums since 68% of the residents are connected with piped water according to Kenya Informal Settlement Improvement Project. Moreover 14% of the total population obtain water from shallow wells while 96 % use pit latrines as human excreta disposal system. The study focused on residents and shallow wells in Munyaka slums. It adopted descriptive research design and stratified random sampling technique to select shallow wells and collect water samples for analysis of faecal coliform levels at the University of Eldoret Biotechnology laboratory using MPN test within 24 hours of sampling. The study area was divided into three zones: Block A, B, and C and 18 shallow wells in area were identified from which ten wells were selected and 10 duplicate samples obtained from each well for analysis of faecal coliform levels. Thirty questionnaires were administered to households that owned the wells and their neighbors that used the wells as source of water to acquire information on water treatment and waterborne diseases incidences. Records of water-borne diseases patients were obtained from Amani Health Center. EXCEL statistical package was used for testing statistical relationships between variables. Raw data for coliform counts were entered in excel spreadsheet and transformed to eliminate zero data points. Results from the laboratory were organized in data-recording sheets and were compared to the standards set by the World Health Organization (WHO). The result of the bacteria count showed a minimum value of 14/100 ml at Well5 and a maximum value of 135/100 ml at Well10. All wells showed presence of coliforms that exceeded the WHO standards of drinking water. It was found that shallow well water in Munyaka was highly contaminated with faecal bacteria and requires disinfection before use since all the wells tested positive to the presence of coliform bacteria. Data records obtained from Amani Clinic showed majority of the residents seek medical attention due to waterborne diseases. Further research on the level of coliforms the other sources of in the area need to be conducted.

Keywords: Coliform, MPN test, shallow well, waterborne, slum.

1.0 Introduction

Rapid urban growth and economic constraints have led to overcrowded slums in Africa's cities, including Kenya, where residents face poor health conditions and limited livelihood opportunities. Kenya's urban population nearly doubled between 1980 and 1998, increasing from 16% to 31%. This rapid urbanization, coupled with economic degradation, has resulted in a growing proportion of people living in absolute poverty and the emergence of informal settlements lacking essential government services such as water, drainage,

sewerage, and rubbish collection. These settlements exhibit poor environmental conditions, contributing to adverse health outcomes.

Access to safe drinking water is a universally recognized human need, yet millions in the developing world lack such access. Rapid urbanization, particularly in peri-urban and slum areas, has further increased the number of people without safe water in urban areas. The United Nations warns that without significant policy changes, access to safe drinking water and adequate sanitation in urban areas will worsen due to rapid population growth between 2000 and 2030, particularly among the urban poor. Inadequate personal and domestic hygiene, along with improper waste management, contribute to the spread of diseases such as cholera, typhoid, hepatitis, and diarrheal diseases. Contaminated water consumption is responsible for one-third of deaths in developing countries, while water-related diseases cause significant productivity losses.

In Kenya, diarrheal diseases are prevalent among slum residents, particularly affecting children. The prevalence of diarrhoea in slum children under 5 years old is twice the rate in Nairobi and the national average. Groundwater and latrine use are incompatible unless specific conditions prevent contamination, such as a low water table and soil characteristics. Guidelines recommend a minimum 15-meter lateral separation between wells and pit latrines, with wells located at least 2 meters above the water table, to reduce the risk of faecal pollution. However, due to rapid urbanization and the expansion of slums in sub-Saharan Africa, on-site sanitation and groundwater use have become common in some urban areas as an affordable option in the absence of government support services.

However, overcrowding in urban slums prevents adequate distance between wells and pit latrines, allowing microorganisms to migrate from latrines into underground water sources. Poor sanitary practices, such as improper disposal of human excreta, further contaminate water and contribute to waterborne diseases. This project aims to assess faecal contamination of domestic water sources in Munyaka slum, Eldoret, Kenya, considering the high levels of diarrheal diseases in urban slums. Slums in Eldoret have experienced rapid growth, lacking basic services like water and sewerage, which negatively impact human health. Poverty, inadequate water quality, and sanitation facilities in slums contribute to waterborne diseases. The urban poor in slums often resort to using inexpensive pit latrines and drawing domestic water from nearby shallow wells due to insufficient water supply. However, overcrowding and poor sanitary practices contaminate shallow wells. To meet domestic demand, people resort to shallow wells or poorly constructed wells with unknown levels of faecal bacteria contamination. Proper hygiene practices are also rarely observed, with a lack of sanitation infrastructure leading to the indiscriminate sinking of pit latrines, septic tanks, and shallow wells, disregarding the environmental and physiochemical factors that affect groundwater quality. This study aims to assess faecal coliform levels in shallow wells and the prevalence of waterborne diseases in Munyaka slum, Eldoret Municipality, to mitigate contamination of the shallow well water and reduce waterborne disease incidence, thereby improving human health for sustainable development.

2.0 Literature Review

The term 'water quality' is used to describe the microbiological, physical and chemical properties of water that determine its fitness for use. Many of these properties are controlled or influenced by substances which are either dissolved or suspended in the water. However, microbiological contamination is the most critical risk factor in drinking water quality with the potential for widespread waterborne diseases (Gadgil, 1998; Gray, 2008; Meinhardt, 2006). Water supplies in developing countries are often devoid of treatment and the communities make use of the most convenient supply (Sobsey, 2002). Many of these supplies are unprotected and susceptible to external contamination of surface runoff, windblown debris, human and animal faecal pollution and unsanitary collection methods (WHO, 2000; WHO, 2008).

The microorganisms that cause disease via drinking water are generally known as pathogens and can be categorized in diminishing size as helminthes (>100 μm), protozoa (5-100 μm), bacteria (0.5- 1.0 μm) and viruses (0.01-0.1 μm). They originate from either human or animal faeces and if they are not removed by water treatment and disinfection, may cause outbreaks of waterborne diseases (WHO, 2004; Gray, 2008)

Bacteria in water and other pathogens cause a variety of diseases. Microorganisms like bacteria, viruses, protozoa, and helminthes (parasitic worms) cause water borne diseases. Sickness occurs when water contaminated with these pathogens is consumed or when water prepared with contaminated water is eaten. Such pathogens are present in human and animal faeces and contamination by such pathogens commonly occurs in area of the world where adequate sanitation is not available or where good hygiene practice are lacking. Poor water supply has profound and liked health and socio-economic effects since ingestion of water contamination by pathogens and toxic chemicals may lead to the spread of water-borne diseases (Mintz et al., 1996). Furthermore, high cost of water treatment, poor accessibility and reliability may result in insufficient quantities of water for household hygiene (Howard, 2001).

There are numerous health related pathogenic microorganisms in water and wastewater discharged into aquatic systems which include traditional microbial indicators such as total and faecal coliforms bacteria (Furedy, 1985; Geld Reich 1986). Total faecal coliforms have been used as significant indicator of possible presence of pathogenic micro-organisms in water and are important components in determining the health conditions of water bodies (Hamilton et al, 1997). Coliforms organisms in water do not all carry the same degree of faecal significance by only origin since it occurs in immense numbers in human and animal intestines. It is therefore claimed to be the most characteristic organism of faeces and its presence in the water can be regarded as evidence of recent excretal pollution of human or animal (Geldreich, 1986). Bacterial species of known excretal origin other than the coliform group, particularly faecal streptococci and clostridium perfringens have been observed to demonstrate possible use in bacterial analysis especially as biological indicators (Baron, 1986). However, there is a drawback in using faecal streptococci as bio-indicator of faecal pollution since they are present in substantial numbers on vegetation and insects that spend part of their life cycle in contact with faecal waste, whereas faecal coliforms are not (Geldreich, 1986). Thus faecal coliforms are better biological indicates since they are also present in human intestines, usually in number that generally exceed those of pathogenic intestinal bacterial (Feng and Hortman, 1982).

3.0 Research Methodology

3.1 The Study Area

The study was carried out Munyaka area which is located in Eldoret East District, Ainabkoi constituency, Kapsoya ward, Chepkoilel location and Sigot sub-location approximately 4.3 km northeast of the central business district. The subdivision of the original farm of 121.4 ha began in the 1980s. The farm is divided into 969 small plots of about 50 m2 each. It has a land area of more than 88 hectares (88.2 ha), situated on an area of slightly rolling hills and has a rural feel to it.

3.2 Research Design

The study adopted a descriptive research design whereby the households and wells among the slum dwellers that used shallow wells as the sole source of water for domestic use were surveyed. The administering of the questionnaires also included the neighbourhood households that obtained water from those wells

3.3 Data Collection

3.3.1 Selection of Water Sampling Wells

A reconnaissance survey was conducted prior to site selection so as to familiarize with the study area and the community. Eighteen shallow wells were identified. The study area was divided into three blocks; Block A with

4 wells, Block B with 6 wells and Block C with 8 wells. Through stratified sampling technique ten wells were selected for sampling. The number of wells sampled in each block was: Block A2 samples, Block B3 samples and Block C5 samples.

3.3.2 Clean Up of Equipment and Apparatus

Ten 200ml glass bottles and ten 100ml bottles for duplicate samples were washed with soap rinsed five times with distilled water and autoclaved at 121◦c for 20 minutes. Petri dishes, fermentation tubes and test tubes were washed and sterilized. The sterilized sampling bottles were placed in a plastic box and carried to the field for collection of water samples from all the respective sampling sites. This was done during the dry season.

3.3.3 Water Sampling For Coliform Analysis

Duplicate water samples were collected from different shallow wells identified in the area of study in sterile 200ml plastic bottles. The bottles were immersed in water below the water surface at representative points and filled to the brim. The cap was then replaced and labelled according to the sites of collection. In case of the well installed with a pump, the pump outlets were washed thoroughly with the site water wiped and water to be allowed to flow for about 10 minutes in order to avoid any residents in the system being taken as a sample. Sampling bottles are filled with water and labelled according to the site of collection. The samples were closed in cool box with ice cubes and transported to the lab for analysis.

3.4 Laboratory Analysis

3.4.1 Multiple Fermentation Tube Method

Most probable number (MPN) method was used to determine the coliform bacteria in water: Water samples were inoculated into LST lactose broth, the positive tubes were confirmed by streaking EMB and Endor agar. Complete test was carried out for the positive tests by inoculating typical colonies into LST broth and later gram staining carried out from the growth on the slant. To calculate coliform concentrations in the well waters sample through most probable number (MPN) the following procedure was used. The MPN test consisted of three steps: a presumptive test, a confirmation test, and a complete test.

3.4.2 Inoculation of Tubes for Presumptive Test:

Sterilized fermentation tubes with Durham tubes inside each of them were in a test tube rack as groups of 3 dilutions i.e. 10ml, 1ml and 0.1ml.The were marked as to their dilutions. Lactose broth was added then incubated in a 35ºC air incubator.

After 24 and 48 hr.: Reading of presumptive tubes and inoculation of tubes for Confirmed Total and Fecal Coliform Tests and for E. coli:

The tubes were gently shaken back and forth several times to release gas in positive tubes. They were examined for the presence of growth (turbidity or cloudiness) and gas (by looking in the small inverted tube), and were scored showing both as presumptive positive. All lactose broth fermentation tubes that were Presumptive positive at about 24 hours and all additional Presumptive positive tubes at 48 ±3 hours were submitted to the confirmed tests.

A sterile loop wire was subsequently inserted into the broth of the positive tubes to a depth of > 1 inch to wet the end. The organisms on the loop wire were transferred to petri dishes of brilliant green lactose bile (BGLB) broth by briefly touching on the surface of BGLB broth. The same procedure was used for positive samples. For each positive Presumptive tube, the inoculating loop wire was sterilized by holding in the flame.

The BGLB broth petri dishes were incubated in a 35ºC incubator. The petri dishes were examined after 24 hours and growth of colonies noted. Those showing growth of colonies scored as Confirmed positive for faecal coliforms.

3.4.3 Complete Test

A colony was isolated from the confirmed positive dishes inoculated in the lactose broth, incubated in a 35ºC incubator for 24 hours. Gram staining was carried out and observation of coliforms under oil done using a microscope.

3.5 Determination of Common Waterborne Diseases

Thirty questionnaires were administered to the households that owned the well in the study area together with the neighbouring households that used the wells the sole source of water. This was carried out in the effort to obtain information on the treatment of water and waterborne disease incidences in the households. Records of patient treated with water-borne diseases cases were obtained from Amani Health Centre were the majority of the target individuals of the slum dwellers normally visit for medical attention.

3.6 Data Analysis

The statistical package EXCEL was used for testing the various statistical relationships between variables. Raw data for coliform counts were entered in excel spreadsheet and were transformed to eliminate zero data points. Results from the laboratory were organized in data-recording sheets and were compared to the standards set by the World Health Organization (WHO).

4.0 Results and Discussion

4.1 Microbiological quality of water

All the samples (10) collected for analysis were found positive for contamination with total coliforms between 14 per 100 ml. and 135 per 100 ml.

The laboratory analysis results of water samples in this study showed that faecal matter had relatively contaminated the shallow wells. The presence of indicator organisms in the water samples indicated that there is likelihood of coliforms migrating from faecal matter in the pit latrines through the soil to the water sources, facilitated by the very short distance between most of pit latrines and the wells as well as use of contaminated containers to draw water from the wells without pump. In addition rains are likely to wash off indiscriminately disposed excreta into shallow wells particularly if the wells are not protected. Therefore, this may have also contributed to the contamination of the generally open shallow wells with faecal matter. None of the shallow wells met the WHO requirements for water intended for drinking which is zero level of coliforms.

4.2 Prevalence of Waterborne Diseases.

4.2.1 Analysis of Secondary data sourced from Amani Health Centre

Information regarding the prevalence of waterborne diseases was collected using retrospective records from the Amani Health Centre, which services the study area. Retrospective data dated from October 2014 to March 2015 was collected. The clinic records were noted with focus on the patients from the study areas.

The common water borne diseases among the households that used shallow well as the sole source of water was typhoid, cholera, Dysentery, amebiasis, worms and skin rashes. The respondents suffered most of these diseases during the rainy season.

4.2.2 Safe Water Use and Water Treatment

Treatment of water extracted from the well of 30 households and the method of water treatment
Despite the contamination of water, it was evident that it was not a common practice for the slum dwellers using shallow well water to treat the water, as only 47% of those who used water from wells said they treated water for drinking. Majority of the respondents used treated water strictly for drinking while the others used it for cooking and bathing was not treated at all.

5.0 Conclusions

The main objective of this project was to determine the levels of coliforms in shallow wells and prevalence of waterborne diseases in the Munyaka slums. The study investigated human faecal matter contamination of the households that uses shallow wells as the sole source of domestic water and the physical characteristics that influence the quality of well water. In most cases the well were not protected and indicate high levels of faecal coliforms. The distance between the latrine and the wells influenced the number of coliforms in various wells. This poses health risk to the majority of the residents who use the water raw without any form of treatment. Health records obtained from Amani Health centre revealed that the majority of the patients within a period of three months showed high incidences of watery diarrhoea of which the majority are children under the age of five.

6.0 Recommendation

The ideal intervention in the long-run may therefore be provision of adequate piped water to all slum dwellers. However, this may take some time, and simpler interventions such as basic sanitary improvement could be put in place in the meantime. Basic sanitary improvement may be worthwhile at the moment. Covering the shallow wells and possibly installing hand pumps or mechanical pumps at the wells could improve the situation.

Basic treatment of the water at the community or household level by chemical disinfection using chlorine, filtration using simple household filters, and boiling should also be promoted to improve the quality of water and prevent waterborne diseases.
Further research should be done to determine other causes of prevalence of waterborne diseases in the area.

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ENHANCING REGIONAL INTEGRATION FOR RESILIENT ECONOMIES

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ABSTRACT

Regional integration has the potential to create resilient economies through the adoption of relevant regional policies that cushion countries from adverse effects of global economic shocks such as the 2019 coronavirus pandemic and the global financial crisis of 2008. To increase the resilience of regional economies, it is vital to consider infrastructural development and trade liberalization by eliminating non-tariff and tariff-based trade barriers among member states. Economic resilience in Africa is hindered by the slow pace of adoption of free trade policies in the region and the lack of the necessary infrastructure and institutions to facilitate the flow of trade and investment. This paper borrows lessons from studies on regional integration in Africa and other developing regions to understand the importance of regional integration and trade in creating resilient economies in the face of global economic challenges such as the COVID-19 pandemic and its aftershocks on the economy. The analysis of these studies indicates that regional integration increases economic recovery through intra-region trade after such a crisis. This paper highlights the need for regional integration in economic growth by creating resilient economies through improved economic relations among member countries and efficient intra-regional trade through infrastructural connectivity. Despite the efforts made, over-reliance on foreign direct investment (FDI) and the lack of political goodwill among member states remain the most significant impediment to economic integration. To strengthen regional integration, African countries should be ready to reduce border restrictions and develop appropriate infrastructure and institutions to enable the free flow of trade to develop resilient local economies that can withstand external economic turmoil.

Keywords: regional integration, economic resilience, regional trade, recession, economic growth, government policy

1 Introduction

In recent years, economists and scientists have increasing sought to understand economic resilience through regional integration. This is attributed to current economic uncertainty arising from the complex global supply chain interdependence between regions and countries that have heightened the risk associated with exogenous economic shocks (Pretorius et al., 2021). The globalized flow of trade enabled through the extensive connection of regions and countries' economies have increased the expected risk of adverse external economic turmoil that impacts internal economies (Pretorius et al., 2017). Global events such as the 2008 global financial crisis, the COVID-19 crisis, and the current Russian inversion of Ukraine continue to have a substantial negative impact on the economies of countries in the global South and especially on the African continent, with long-lasting effects.

The COVID-19 pandemic, regarded by the United Nations Economic Commission for Africa (UN-ECA) as an economic, security, and humanitarian disaster for the African continent, has had a substantial economic cost, with GDP growth dropping from 3.2% in 2019 to -2.6 in 2020 (ECA, 2021). The GDP drop was regarded as Africa's worst economic projection of the International Monetary Fund (IMF). Loss of income and jobs has forced over 55 million people across Africa into poverty due to the disruption of global distribution channels

and economic contraction brought by the COVID-19 pandemic (ECA, 2022). The pandemic was directly responsible for the adverse interruption of demand-supply chains globally in developing countries, especially in Africa, bearing the brand of the pandemic. These two recent events and the previous financial crisis created by the housing bubble in the United States in 2008 necessitate us to understand sustainable and resilient ways developing economies in the global South can adapt to cushion themselves from adverse external effects of these events.

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2.0 Literature Review

2.1 Regional Integration

The United Nations Conference on Trade and Development (UNCTAD) defines regional integration as the process that entails increasing the economic interconnectivity of countries within a particular region through collaboration and the adoption of identical policies and practices. (UNCTAD, 2021). According to Claveria and Park (2018), the main components of regional integration include; regional value chains, money and finance, trade and investment, movement of people, social and institutional integration, and infrastructural connectivity. Similarly, the Economic Commission for Africa et al. (2019) addresses seven essential facets of African regional integration; migration and free movement of people; trade and investment integration; health integration; mining integration; macroeconomic convergence and monetary and financial integration; and governance, and peace and security. This paper addresses the need to integrate these aspects across African countries in promoting economic resilience among member states of regional economic blocks.

Africa has come a long way in advocating for economic cooperation among African states in terms of regional integration. Currently, there are eight regional organizations fully recognized by the African Union (ECA et al., 2019). They include the South African Development Community (SADC) for Southern Africa; the Economic Community of Central African States (ECCAS) for Central Africa; the East African Community (EAC) for East Africa; Common Market for Eastern and Southern Africa (COMESA) for Eastern and Southern Africa; Economic Community for West African State (ECOWAS) for West Africa; Intergovernmental Authority on Development (IGAD) for the Horn of Africa; Arab Maghreb Union (AMU) for North Africa; and the Community of Sahel-Saharan States (CEN-SAD) for Sahel region and Sahara region countries (ECA et al., 2019). These RECs aim to advance economic growth and employment to reduce poverty, agricultural transformation, industrial development, and value addition through increased production value chains and export diversification (Tsakok, 2021). These aspects of regional integration are essential in promoting sustainable economies, a critical factor in economic resilience

The Africa Regional Integration Index (ARII) report of 2019 notes that regional integration enables countries to reap maximum benefits from globalization and, at the same time, counter adverse effects of global trade while stimulating development through infrastructural investment and improved production capacity in the developing countries (African Union et al., 2019). Therefore, regional integration can enable African countries to eradicate poverty and attain economic growth achievable through the proper harnessing of opportunities for greater regional integration (UNDP, 2011). UNCTAD underscores the importance of regional integration among developing countries in promoting peaceful co-existence between states and reducing the exposure of local economies to external economic volatility and the cost of facilitating trade (UNCTAD, 2019). Therefore, regional integration enables countries to simplify and streamline both legal and technical procedures to facilitate import and export trade, which is essential for economic growth.

The introduction of the African Continental Free Trade Area (AfCFTA) implies that Africa can be united under one economic block, which will be the largest in the world, with a market of over 1.2 billion people (UNCTAD and ECA, 2019). The launch of AfCFTA in January 2021 gives fresh stimuli to the integration agenda in Africa (ACET, 2021). The agreement, which has so far been signed by 54 of the 55 African Union member states and ratified by over 20 countries, seeks to accelerate intra-African trade and boost the competitiveness of African products on the international market through the establishment of free trade areas, elimination of tariff and

non-tariff barriers to trade among member states, and free movement of labor and capital (ACET, 2021 and UNCTAD, 2021). Therefore, the AfCTA agenda is bound to foster inclusivity in growth and post-pandemic economic resilience in Africa.

2.2 Economic Resilience

Understanding resilient economic systems originate from studies on ecological systems' ability to withstand external interference (Pretorius et al., 2017). Pretorius explains economic resilience as the ability of an economy, local or regional, to withstand and recover from exogenous disruptions. An economy is viewed as resilient if it can resist or absorb the impacts of the external disruptions and seamlessly re-adjust and adapt to regain production and output as per the initial economic growth after the disruptions (Pretorius et al., 2017). Economic resilience can also refer to the ability of individual firms and households to resist and survive economic disruptions, especially in distribution systems, and effectively adapt to the current circumstances (Cardiff University, Undated). Therefore, economic resilience focuses on reducing the aggregate welfare loss from vulnerable sectors of the economy which are susceptible to external economic disruptions. It is imperative to understand how an economy can absorb external shocks and the ability of households and firms to respond to these economic disruptions.

According to the Economic Commission for Africa, a country's vulnerability depends on certain "inherent" features such as economic openness, export concentration, and import dependency (ECA, 2022). The external vulnerability arises from structural economic factors beyond the country's grasp or control. In the event of economic disruption, such as the COVID-19 pandemic, economic resilience is viewed in terms of how the government handles the situation to ensure stability, reduce uncertainty and promote recovery of the economy. Pretorius argues that the recovery of economies after an external disruption is not a one-step process but rather a long-term process to enable timely recovery and develop the ability to withstand future shocks (Pretorius et al., 2021). The author also notes the importance of the economy to balance between recovery from external shocks and the ability to withstand the shocks as they occur since focusing on one aspect of resilience is likely to create loopholes in the economy that will render it susceptible to future shocks (Pretorius et al., 2017). To identify resilient economies, criteria such as living standards, the rate of employment, quality of life, and the rate of economic growth need to be understood before, during, and after the economic disruption and the expected growth trajectory of the economy.

Countries encounter a wide range of adverse economic events, including commodity price fluctuation, debt crises, financial crises, and global economic volatility (Sánchez et al., 2015). According to Sanchez, these adverse economic events can exacerbate uncertainty and risk among consumers, producers, and governments. On a large scale, these crises can trigger economic downfall, which reduces GDP growth and eventual stagnation of the economy (Sanchez et al., 2015). Economies are likely to be affected by external shocks if they heavily depend on a narrow range of exports. The lack of export diversification predisposes economies to external shocks, likely to cripple the economy (Briguglio et al., 2006). The over-dependence on vital imports such as oil and heavy machinery makes a country's economy vulnerable to economic disruptions that affect the cost and availability of these vital imports. This is clearly evident today as African economies grapple with the skyrocketing prices of basic commodities attributed to the Russian invasion of Ukraine which has led to the scarcity of crude oil, an essential element in the production process, fertilizer; needed for agricultural production; basic food product including wheat, maize, and sunflower which sustain various nutritional needs across the globe and especially in Africa. Economic resilience in Africa can be sustained through improved human economic well-being by diversification of production and service lines, making competitive exports, increasing productivity in agriculture and industries, and technological upgrades in manufacturing, agriculture, and mining.

The advent of the COVID-19 pandemic exposed the vulnerability of economies in the global South and the lack of unity among developing countries in managing production value chains during the crises. The financial constraint caused by the COVID-19 pandemic shocks and further exacerbated by the Russian invasion of Ukraine has had a ripple effect across economies of developing countries, with African economies dependent on global trade baring much of the brand. Economies in the global South are expected to take time to recover from this recessionary trend that is currently being experienced globally (UNCTAD, 2020). These and many other challenges necessitate the need to build sustainable and resilient economies through regional integration to cushion developing economies against the current and future adverse global economic events.

2.3 Regional Integration and Economic Resilience

Regional integration in Africa offers producers access to regional markets and links to regional value chains greatly increasing competitiveness and enhancing production capacity. This enables the producers to develop and compete effectively on the global market. Therefore, regional integration is the key to boosting productivity and improvement of living standards across the continent. Regional integration also offers the opportunity for African countries to grow and develop by improving the competitiveness of African products through product and export diversification and increasing economies of scale which are currently hampered by high transport costs and the small scale of the individual country economies. Therefore, regional integration guarantees efficiency in production and price harmonization across countries and regions through increased competition in the local markets due to wider access to a variety of commodities. Regional integration also permeates technological transfer and innovation across countries enhancing fair competition with developed economies on a global scale. Increased regional integration is also an essential enabler of reduction in inappropriate domestic policies and adoption of relevant regional macroeconomic policies. The development of regional infrastructures such as roads, railways, ports, and telecommunication networks through regional integration is a great enabler of cross-border trade, movement of labor, investment, and financial flow. The net effect of regional integration is greater food security through intra-African trade in agricultural products and support for value addition mechanisms and an international supply chain for agricultural produce. On average, a third of the African population resides in landlocked countries. therefore, this unique geographical factor highlights the need for regional integration to ease the access to markets within and beyond Africa.

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3.0 Research Methodology

The paper undertook a systematic literature review of various scholarly articles, publications, reports, periodicals and policy reviews focused on regional integration, economic resilience, and regional economic integration. The literature search covered Google Scholar, and other specific organizational websites for relevant literature on regional integration and economic resilience. The search strategy involved the use of the following keywords: "regional integration," "economic resilience", "regional economic integration", "regional trade", and "regional integration in Africa". The search results were limited to articles and books published after the 2008 global financial crisis up to Feb 2022, focusing on regional integration and economic resilience among economies of developing countries/ regions.

This paper used systematic simple random sampling of the above online sources to select 20 different articles based on their title, objectives, and discussions. Only articles that met the author's criteria as stated above, were selected for this article.

4.0 Results and Discussion

4.0 Findings.

Of the 20 articles sampled and analyzed, six relevant articles for this title were conveniently sampled and adopted for review and analysis. These articles bring together conceptual and policy issues and comparative and empirical analyses on the theme of regional economic integration and economic resilience.

This paper found that three of the selected studies from Ncube et al. (2014), Pretorius et al. (2017), and Pretorius, et al. (2021) focused on understanding the role of regional integration in promoting resilient economies with particular attention to the SADC and EAC communities. The studies assessed the level of recovery of these regions after the 2008 global financial crisis.

On the other hand, another study by Sanchez et al. (2015) analyzed the role of economic policies in strengthening economic resilience against adverse shocks. The paper assessed policies that enable the preparedness of economies against adverse economic events.

Two other studies discussed the challenges and prospects of regional economic communities across Africa. These articles gave a wide range of challenges that African RECs grapple with in their quest to improve intra-regional economic growth and development across the African Continent (Mlambo, 2019 Tuluy, 2016). They also documented the potential of these RECs in addressing these challenges towards achieving their goals.

4.1 Discussions.

The study compared the impact of the global financial crisis on two regional economic communities in Africa, the East African Community (EAC) and the Southern African Development Community (SADC). The findings revealed that the EAC was more successful in absorbing and mitigating the aftershocks of the crisis, while the SADC suffered greatly. The vulnerability of SADC was attributed to weak regional integration and over-reliance on South Africa as its economic powerhouse. Diversification of regional trading partners and trade links was identified as crucial for building resilient economies.

The research highlighted the importance of balanced policies that promote the development of supply value chains, increase intra-regional trade, and enhance regional integration. Intra-regional trade and inter-country trade were found to strengthen the capacity of local economies to reduce volatility and exposure to global shocks. Diversifying export markets to low-income regional partners was emphasized to improve resilience in adverse economic events. Open economic policies that promote growth and response mechanisms were also recommended.

Monetary and structural policies were identified as key elements of resilient economies, including aspects such as the labor market, financial market, product market, taxation, and housing market. Sound policies in these areas were deemed essential for absorbing external economic shocks and stabilizing the economy. Regional integration in Africa was seen as crucial for sustainable supply and value chains.

Challenges to regional integration were identified, including low growth per capita, lack of access to means of production, political instability, underdevelopment of member states, and unequal economic development. Harmonizing trade policies, improving infrastructure, reducing barriers, and addressing conflicting interests among member states were recommended to enhance resilience. The African Continental Free Trade Area (AfCFTA) was seen as a promising initiative for solving integration challenges and promoting economic resilience.

To realize integrated economies, political stability, democratic governance, regional investment, infrastructural development, cross-border trade, industrialization, and free movement of people were identified as important factors. Export diversification, reduction of non-tariff barriers, and political goodwill in implementing regional integration were highlighted as necessary steps. Implementing these recommendations, including those outlined in the AfCFTA agenda, would foster inclusive economic growth, sustainability, and resilience in Africa, particularly in the post-COVID-19 era

5.0 Conclusions

From the above discussions, it is evident that regional integration has the potential to accelerate and transform the growth and development of Africa's fragmented economies through increased output and trade. The improved mobility of goods, finances and labour across borders in recent times among African countries has the potential to unlock growth opportunities that enhance the ability and capacity of the regional economic systems to sustain initial disturbances in the market. The complexity of global production value chains and the volatility of foreign direct investment (FDI) to financial risk, as observed during the 2008 financial crisis and the COVID-19 pandemic, implies that regional economic blocks remain at risk of external turmoil emanating from developed countries

Despite the efforts made, over-reliance on foreign direct investment (FDI) and the lack of political goodwill among member states remain the most significant impediment to economic integration. To strengthen regional integration, African countries should be ready to reduce border restrictions and develop appropriate infrastructure and institutions that will enable the free flow of trade to develop resilient local economies that can withstand external economic turmoil.

6.0 Recommendation

The recent events from the COVID-19 pandemic and the Russian invasion of Ukraine characterized by vaccine hoarding, petroleum export bans, wheat export bans, and palm oil export bans should serve as a reminder that African nations will be left to suffer if appropriate collaborative mechanisms are not initiated to support intra-Africa trade cooperation towards self-efficiency. Therefore, economic resilience in Africa can be achievable through regional integration across the continent by reducing over-reliance on global value chains in Europe, Asia, and the Americas for essential commodities.

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EMPLOYMENT OPPORTUNITIES AND YOUTH PARTICIPATION IN COUNTY DEVELOPMENT PROJECTS IN KAKAMEGA COUNTY

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A B S T R A C T

Youth participation in county development projects continues to worsen, though they are majority. Therefore, this study investigated the effect of employment opportunities on youth participation in county development agenda. Further, it examined the influence of Employment opportunities on young people participation in county development agenda with the particular focus on the rationale for their participation behaviors. Target population was 1000 youths with sample size 400.Explanatory survey research design was used to show cause effect relationship between employment opportunities and youth participation. Structured questionnaires were used and researcher tested validity of instruments by discussing them with experts. Reliability was tested using cronbach alpha for consistency of data. Test re- test technique was done during pilot testing to test reliability of research instruments. SPSS was used for data analysis, presentation done using tables for easier communication of findings. The study findings reveal a positive high correlation between Employment opportunities and Youth Participation in Development projects (R= 0.79). This shows employment opportunities positively influences youth participation in development projects in Kakamega County and recommends that government formulates policy measures and programs that champion creation of employment opportunities for youth so as to involve them in development projects since young people are energetic greater asset and engine for wealth creation for the country. In conclusion, training increases youth participation in development agenda in Kakamega County. This study will mitigate existing different, conflicting opinions on Employment opportunities and youth participation in development.

Keywords: Employment opportunities, Youth Participation, participation behaviors

1.0 Introduction

The United Nations (UN) defines youth as individuals between the age of 15 and 24 while on the other hand, Kenyan Constitution define youth as any individual between the age of 18 and 35 (Njonjo, 2010) .
Youth participation is the process of involving or engaging young people in decision making, sports, schools and even development activities throughout the community (Mugure, 2013). Youth should be involved in shaping present and future development agendas so that they are part and parcel of determining their future and not leave it to old jabs who are only interested in championing their own interest at the expense of youth.

Globally, there is increasing recognition of the importance of youth participation in decision-making. In 1995, the UN General Assembly acknowledged the potential of young people in driving social change and economic growth. Subsequently, policy frameworks and resolutions have emphasized the need to empower youth and engage them in development, conflict resolution, gender equality, and decision-making.

Locally, youth participation is recognized in the African Charter for Participation in Development and Transformation, emphasizing their right to be involved in decisions that affect their lives. However, a study by Kenya Youth Charter (2013) highlights the discrimination and marginalization of youth in politics, economy, and society. The youth continue to experience diminished aspirations for jobs, limited freedom, social injustice and their deep alienation from the system. ILO (2012) cautions that economic and social exclusion of youth

gives rise to acute inequalities in terms of wealth and income which ultimately has caused youth-led protests against economic injustice across the world.

To address this, it is crucial to provide employment opportunities, reduce poverty, and promote wealth creation. This can be achieved by equipping youth with necessary skills and capital, attracting investments, and involving stakeholders in regional integration and development planning. Creating an enabling environment and allocating resources for youth programs will unlock their full potential and improve their quality of life

The objective of this study was to investigate employment opportunities and youth participation in county development agenda in general and specifically to examine the influence of training opportunities on Youth involvement in development of Primary Schools in Kakamega County, Kenya.

2.0 Literature Review

Employment and Employability are fundamental components for youth development. Employment is defined as an occupation by which one earns a living. It implies the activity or work for which a person has been engaged and is being paid for (Dictionary.com. According to Wikipedia, "Employability" can be defined as "doing value creating work, getting paid for it and learning – at the same time enhancing the ability to get work in the future".

Employment and Employability are closely linked concepts. Employability is related to work and the ability to be employed. These abilities or skills, as they may be called, include: ability to gain initial employment, ability to maintain employment and ability to obtain new employment (Dawes, 2013) It is believed that youth development programmes require fundamental changes so as to become more responsive to the needs of young people to become more employable (Elima, 2017). Employment is a state of having a job for which you are paid. Currently, job creation has been a critical issue in addressing socio-economic development (UNDP, 2013).

However, Universities and colleges spearheading education has been blamed on churning out half-baked graduates who lack required skills to meet the needs of job market. Youth unemployment in Kenya has mysteriously shot to over 75 percent and almost 60% of youth churned out by education system in Kenya continue to be worst hit by unemployment (Juma, 2018). On the other hand, Global risk report (2014) classifies youth unemployment as a risk of greatest concern in 2014 since it directly influence security, economic growth and corruption indexes. Similar argument were made by Msigwa and Kipesha (2013) who agrees that youth unemployment resulting from youth bulge has worsened the state of affairs in most countries due to its consequence on crime levels, violence protests on social injustice and activism against discrimination by leaders elected based on negative ethnicity. Nevertheless, a solution to this pandemic is increasing youth employment can decrease risk factors and help mitigate engagement dynamics (Omolo, 2012).

3.0 Research Methodology

3.1 Research Design

The study used explanatory survey research design to assess the determinants of youth participation in county development agenda. This design was selected as it was able to detail cause effect relationship of the behavior of youth in participating in county development agenda Shields et al. (2013).

3.2 Population and Sample.

The model summary showed that $R^2 = 0.568$; implying that 67.8% variations in the Youth Participation is explained by Employment opportunities while other factors not in the study model accounts for 33.2% of variation in Youth Participation in development agenda. Further, coefficient analysis shows that Employment opportunities has positive significant influence on Youth Participation ($\beta = 0.812$ (0.081); at $p<.01$). This shows that rise in Employment opportunities would lead to 0.812 unit increase in the Youth Participation resulting to linear regression equation which is;

$y = 0.921 + 0.801X1$

Where;

y = Youth Participation.

X1 = Employment opportunities

4.0 Conclusions

This study tested the influence of employment opportunities on youth participation on development agenda. Basing on the finding, it is concluded that Employment opportunities determines youth participation in development agenda. Hence the government and other stakeholders can increase the participation of young people in development projects and agenda through creation of more job opportunities for them.

5.0 Recommendation

The study recommends that more employment opportunities should be created for young people within the counties, this will boost their participation behaviour in development projects.

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NUTRIENT AVAILABILITY AND EFFECT OF COMPOSTING OF WASTE AGRICULTURAL SUBSTRATES ON WOOD EAR MUSHROOM (AURICULARIA AURICULA) CULTIVATION.

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ABSTRACT

Auricularia auricula L ranges from purple to dark brown or black in color with a rubbery texture. They are indigenous to Kakamega forest mostly harvested by communities residing around the forest for food. The forest is rapidly being destroyed to create land for agriculture and settlement. To conserve the mushroom, there is need to develop alternative substrates for the cultivation of this species. Wood ear mushroom production is inevitably one of the least vulnerable of all the horticultural industries to climate change because most core production activities occur inside growth rooms. This study was designed to determine appropriate proportion of composted substrates and supplements for the cultivation of the mushroom, to evaluate the various nutrients available in the substrates when composted and how they influence wood ear mushroom growth. The study was conducted at the Masinde Muliro University using sugarcane bagasse, maize cob, grass, sawdust and wheat straw while the supplements included wheat and rice bran. Mushroom productivity values recorded included mycelia density, spawn run duration, duration to primordia initiation, and duration to fruit body development, fruit body quality and quantity of mushroom. The experiments were arranged in a Completely Randomized Design with four replications. Data was subjected to analysis of variance using SAS programme to determine whether the treatment effects were significant at 5%. Least Significant Difference test was also used to separate means. Standard Error was used to separate means with significant interaction of factors. Correlation analysis was done to compare some of the variables. The shortest duration to spawn run was obtained with composted maize cob at 5 days when supplemented with 10% wheat bran, while the longest duration of 14 days was observed in sawdust. The non-supplemented maize cob and 20% wheat bran supplemented maize cob completed 8 and 7days respectively to spawn run. There was no fruiting in sawdust. The study demonstrated that nutrient content of locally available organic substrates is made more available when partially composted and that they enhance growth and yield of wood ear mushrooms.

Keywords: Wood ear mushroom, composting, climate smart, substrates, nutrients, yield

1 Introduction

There is a strong desire globally to see people come out of long-lasting food insecurity and poverty. Most areas are vulnerable to climate change and are commonly hit by drought, which makes the inhabitants to rely on food aid. Mushroom cultivation is a profitable agribusiness that can improve the economic and food status of farmers in dry areas through simple alternative solutions (Shakil et al., 2014). Historically, mushrooms were procured by gathering naturally but due to rampant destruction of forests and over - harvesting of the few remaining indigenous mushrooms, the establishment of various cultivation methods such as wooden logs, bags, bottles and beds have been employed. (Dhar, 2017). No commercial cultivation of wood ear mushroom has been practiced in Kenya (Onyango et al., 2011) hence negative impact on biodiversity and availability for the future (Palapala, 2006). To this effect, the present study was designed to evaluate the suitable substrate state and their nutrient - growth parameters for cultivation of wood ear mushroom in Kakamega - Kenya. Preliminary results of Palapala (2006) suggested that local agricultural wastes have the potential to support cultivation of African wood ear mushrooms under bag culture. However, one of the challenges is the identification of substrates that

are readily available locally which are suitable for its growth and development (Maffstat 2004). Moreover, each mushroom has specific growth parameters which must be fulfilled for successful cultivation. These precise conditions can be quite difficult to reproduce, but they are very crucial in cultivation (Mycosource Inc, 2006). The study was able to evaluate the effect of composted sugar baggase, wheat straw, grass, maize cob, and wood sawdust as cultivation substrates, on the performance of indigenous wood ear mushroom. It was also able to determine the wood ear mushroom production efficiency of varied substrate nutrient composition. No chemical components were necessary for its cultivation as it is an organic and ecofriendly vegetable (Shakil et al., 2014). The study would contribute to the popularization and consumption of wood ears by local communities as a balanced meal, to end hunger, treat diseases and improve food security. In addition, it is anticipated that the hotel industry will consider the utilization of the species.

6.0 Literature Review

Employment and Employability are fundamental components for youth development. Employment is defined as an occupation by which one earns a living. It implies the activity or work for which a person has been engaged and is being paid for (Dictionary.com. According to Wikipedia, "Employability" can be defined as "doing value creating work, getting paid for it and learning – at the same time enhancing the ability to get work in the future".

7.0 Research Methodology

3.1 Spawn production

Malt extract agar medium was prepared by weighing 25 grams of 2% of the culture medium and dissolving it in 500 milliliters of distilled water (HI Media lab PVT Ltd.) then autoclaved at 115°C for 1 hour. They were poured into sterile 9 cm petri-dishes while still hot. A healthy Auricularia auricula from Kakamega forest was cleaned in sterile water and cut into 1-2 cm pieces then placed into 2.5% sodium hypochlorite for 30 seconds and into 70% ethanol for 30 seconds. The pieces were then dried on sterile filter paper. Individual pieces were picked by sterilized forceps and placed on 2% Malt Extract medium. 3-4 pieces of wood ear mushroom were placed in each dish then covered and sealed using para-film before incubating at 30°C for seven days. One established culture was sub-cultured into fresh medium according to the methods of Onyango et al., 2011.

3.2 Spawn production

This was carried out following the methods of Nandi and Palapala 2009; Millet and wheat bran were cleaned manually to remove unwanted materials. They were well mixed at ratio of 4:1 respectively. The grain was soaked in water for 24 hours then drained by air for 30 min. Culture bottles of 1litre volume were washed and sterilized for 30 min at 121^0C for the preparation of spawn culture. One kilogram of substrate per culture bottles was used. Thirty grams of calcium carbonate (CaCO3) was added and thoroughly mixed into the grains which had initially been mixed with 10% wheat bran, soaked, drained and air dried. The bottles were sterilized at 121^0C for 30 min then left to cool under the laminar flow hood. Inoculation was done with 3-4 agar blocks each measuring $1cm^{2.}$ The inoculated spawn bottles were incubated at 25^0C for 21 days for mycelial growth in darkness until the mycelium fully covered the grains. It was shaken every four days to distribute mycelium throughout the grain till the end of the growing day according to the methods of Tesfaw, 2015.

3.3 Non-composted substrate formulation

Five substrates namely, sugar bagasse (Saccharum officinarum), couch grass (Cenchrus ciliaris), maize cobs (Zea mays var H624), wheat straw (Triticum aestivum L.subsp.aestivum) and sawdust (wood shavings from Sweitenia mahogany, Ficus exasparata and Ficus thorningu trees) were collected locally. Wheat and rice bran were obtained from animal feeds shop. Cultivation substrate preparation was done according to Magingo (2004) with each substrate weighing 300 gm including 10% supplement were packed in polythene bags. The end of

each bag was tied loosely with a sisal rope before sterilizing at 121^{0}C for 10 min in an autoclave. The polythene bags were cooled to room temperature then removed from the autoclave. They were then placed in a disinfected laminar flow hood where the ropes were loosened. A sterilized table spoon was used to scoop 20 grams of spawn culture and placed on top of the substrates. All the inoculation procedures were done inside a lamina flow bench. The open ends of the bags were rapidly covered using sterile cotton wool, labeled and transferred to a sterile room in total darkness to allow complete colonization of the substrates according to the methods of (Onyango et al., 2012). The number of days to complete colonization was recorded per bag as the spawn run duration

3.4: Composted substrate formulation

Similar agricultural substrates as in 2.3 above was used. Each of the substrates were dried for 2hrs under the sun and cut into small pieces (< 4cm) using a sharp knife. To each substrate, rice and wheat bran supplements were added to the substrate: supplement ratio of 9:1 and thoroughly mixed. The composting procedure was done in accordance to the methods of Adjapong et al., 2015 and squeeze test according to the methods of Nandi and Palapala (2009). The substrates were divided into lots of 1 kg each and packed into heat resistant polypropylene bags and the same procedure as done for non-composted substrates was followed.

3.5 Primordia and fruit body initiation.

The bags were subjected to temperature shock in a freezer for one hour before being transferred to a disinfected room with wooden shelves covered in formica. Slits were made on the sides of each bag for aeration and fruiting body development. Primordia initiation and density were recorded, and cotton plugs and papers were removed for better aeration. The room temperature was maintained at 23-25°C, and the substrates were sprayed with water twice a day. Fanning and lighting were provided to regulate temperature and provide a 12-hour light cycle. Fruit bodies were harvested when mature, and their quality was evaluated based on shape, size, and texture (Thiribhuvanamala et al., 2005; Magingo et al., 2004; Rodgers, 2007).

3.6 Determination of suitability of substrate nutrient content on wood ear mushroom growth and yield.

Samples consisting of substrates and 10% wheat and rice bran supplement were generated to obtain nutritional composition of fresh non-composted and composted substrates. They were analyzed for nutritional content in the laboratory. Each of them was completely dried and cut into about (<4cm) pieces using a knife and ground to powder form using an electric blender. The substrates were sieved through a 5 mm mesh and each sample stored separately in bottles with airtight lids in a refrigerator until subjected to analysis of nutrient content. Determination of moisture content, protein, ash, cellulose, hemicellulose, lignin content of both composted and non-composted substrates was done according to the methods of Van Soest et al., 1991).

3.7 Data collection and Analyses

Data on quantitative growth characters were subjected to analysis of variance (ANOVA) at 5% level of significance using the SAS version 9.1 (SAS Institute, 2005). Least significant difference and standard error margin were obtained to compare the means of duration to spawn run, primordia initiation, fruit body formation, average fresh weight of mushrooms and fruit body quality. Correlation analysis was done to determine the relationship between mushroom growth parameters and nutritional contents of substrates.

4.0 Results and Discussion

It is clearly evident that maize cob shortened primordial emergence in comparison to all other substrates (Table 2). Duration to fruit body development was different between all the substrates. Sawdust did not produce any fruit body. Grass straw without supplement took the longest duration of 23 days to produce mushroom fruit

bodies. It was followed by Bagasse without supplement (17 days); maize cob with rice bran supplement took the shortest duration of 8 days. Maize cob was therefore the fastest to produce fruit bodies.
Very significant differences were recorded on the substrate nutrient availability among the substrates and supplements tested. Fresh and composted substrates showed highly $p \leq 0.05$ significant differences in most of the nutrients tested, composted substrates leading in most of the nutrients. The ash content was significantly $p \leq 0.05$ higher in composted substrates 20.9% than the non-composted ones 7.8%. A highly significant $p \leq 005$ difference was recorded in the hemi-cellulose content of the substrates whereby; it was higher in non-composted substrates than in composted substrates. Crude protein content was higher in composted maize cob + wheat bran and wheat straw + wheat bran substrates, 8.6% and 9.4% respectively whereas the non-composted ones were 8.2 % and 7.9% respectively. There was a significant $p \leq 0.05$ increase in moisture content in most of the substrates which were composted.

4.1 Correlation analysis of growth parameters and nutritional contents of substrates

The strongest (R2=0.83) positive correlation was obtained between duration to spawn run and duration to primordia initiation. Similar correlation value (R2=0.83) was observed between number of fruit bodies and the fruit body quality. The lowest positive correlation (R2=0.02) was between cellulose content and fruit body quality. Same correlation value was found between hemi-cellulose content and duration to spawn run. Very strong negative correlation also occurred with the strongest negative values of (R2=-0.95) between crude protein content and duration to spawn run. In all the nutrients tested, crude protein had the highest negative correlation with spawn run and primordial initiation. Increase in crude protein content is therefore found to reduce the number of days to spawn run and primordial initiation. Ash, lignin and hemi-cellulose contents were positively correlated with spawn run and primordia duration, this means that the above nutrients significantly increased the duration of mushroom development. Duration to fruit body development was positively (R2 = 0.08) correlated with fruit body quality implying that the longer the duration the better the quality. The second highest negative correlation of (R2 = -0.93) was found between duration to primordia initiation and the number of fruit bodies. The correlation of (R2 = -0.91) occurred twice, one was obtained between spawn run duration and fruit body quality and between duration to primordia initiation and fruit body quality indicating that the shorter the duration to spawn run and primordial initiation, the better the quality of mushroom fruit bodies. Lignin content had a positive correlation with duration to primordia initiation and that of fruit body development. Increase in lignin content significantly increased the duration of mushroom growth

4.2 Correlation analysis of growth parameters on nutrient content of non-composted substrate.

The highest positive correlation of R2 = 0.98 was found between duration to primordia initiation and number of primordial. This indicates that the longer the duration to primordia initiation the more the production of primordia. The highest negative correlation of R2 =-0.97 was recorded between duration to spawn run and duration to primordial initiation. Hence when the spawn run delays, primordia take a longer time to initiate.

4.3 Discussions.

Composting reduced lignin, cellulose, and hemi-cellulose content while increasing moisture, ash, and crude protein content in substrates. Composted substrates had higher moisture content and improved water retention capacity compared to non-composted substrates. High humidity was recommended for primordia formation, but it should be lowered once primordia form. Composting softened substrates, increased water holding capacity, and eliminated contaminants. Ash content positively correlated with spawn run duration, primordial initiation duration, and fruit body quality, but negatively correlated with the number of fruit bodies. Cellulose and hemi-cellulose content decreased significantly due to composting. Crude protein

content increased with composting and correlated with shorter primordial initiation duration, higher fruit body quality, and increased number of fruit bodies. Moisture negatively correlated with spawn run duration. Lignin content had a negative correlation with fruit body number, while protein content had a positive correlation. Composting improved substrate nutritional value and colonization time, but lignin content delayed spawn run duration (Tisdale, 2004; Bachara, 2007; Kivaisi, 2007; Gregory et al., 2007; Akinfemi et al., 2009).

5.0 Conclusions

The study demonstrated that many locally available organic substrates have high potential for utilization as substrates and supplement for wood ear mushroom production when partially composted. Composting made available most nutrients necessary for mushroom growth and development. Wood ear mushroom is both a primary and a secondary saprophyte but does better on composted substrates.

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ROLE OF FINANCIAL SKILLS ON THE MANAGEMENT OF CAPITATION AND DEVELOPMENT GRANTS IN NATIONAL POLYTECHNICS IN MT. KENYA REGION

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ABSTRACT

Education is a human right that has immense power to transform society. Given the prevailing hard economic times and scarcity of funds allocated to tertiary institutions in Kenya, financial management in National Polytechnics has become more vital as demand for quality tertiary education rises. This study sought to investigate the role of financial skills on the management of capitation and development grants in National Polytechnics in Mount Kenya Region and the specific objectives were to; examine the role of financial reporting skills, assess the role of budgetary skills, determine the role of internal auditing skills and to establish the role of information communication and technology skills on management of capitation and development grants in National Polytechnics in Mount Kenya Region. The study was guided by pecking order theory and agency theory and adopted a descriptive research design on a sample of 39 respondents comprising principals/ deputy principals, finance officers and accountants and academic HODs charged with dispensing development grants. Closed ended questionnaire was used whose reliability and internal consistency was ascertained using the Cronbach's alpha coefficient and a coefficient of at least 0.7 was acceptable. Descriptive analysis produced totals, percentages, mean and standard deviation and the inferential statistics comprised of correlation between variables since this was a correlational study. The findings revealed a strong positive correlation between financial reporting skills and management of capitation and development funds with a significant correlation coefficient of 0.78, budgetary skills was second with second with r= 0.661, ICT skills with r=0.543 and the least was internal auditing skills with r=0.502. All the correlations were significant at p=0.005. It was concluded that financial reporting skills, budgetary skills, ICT skills and internal audit skills all have a significant positive role in the management of capitation and development grants. The study recommended skill upgrading in ICT skills, internal audit skills and budgeting skills to comply and align with the existing financial and accounting standard.

Keywords: Capitation, grant, financial reporting, internal auditing, budgeting

1 Introduction

Education is a human right that has immense power to transform society and whose foundation rests on the cornerstones of freedom, democracy and sustainable human development. Education provides knowledge and skills needed to succeed in life. Furthermore, education is associated with increased incomes, reduced poverty and improved health (UNICEF, 2006). Kwame (2011) states that improving educational access is a journey through several paths and trajectories landing with the introduction of capitation grants to eradicate fees in learning institutions. Available education statistics data suggests that in its first year the introduction of capitation grants produced a seismic shift in demand as hoped for by policy. The principle behind introducing capitation was that it would eliminate household need to pay fees for education, especially for the poor who it had been shown were not accessing education because of the costs, and enable TVET institutions to use the funds to improve the quality of education.

In Kenya, financial reporting is regulated and controlled by the Accountants Act, 2008 which is an Act of Parliament to provide for the establishment, powers and functions of the Institute of Certified Public Accountants of Kenya and the Kenya Accountants and Secretaries National Examinations Board; to provide for the examination of accountants and company secretaries and for the registration of accountants, and for connected purposes (ICPAK, 2014). Further, ICPAK (2014) states that financial Reporting involves the disclosure of financial information to the various stakeholders about the financial performance and financial position of the organization over a specified period of time. The typical components of financial reporting relevant to this study include the financial statements namely, balance sheet, profit & loss account, cash flow statement, quarterly and annual reports. According to Winkler and Yeo (2007), the main purposes of financial reporting Providing information to the management of an organization which is used for the purpose of planning, analysis, benchmarking and decision making, providing information to investors, promoters, debt provider and creditors which is used to enable them to make rational and prudent decisions regarding investment, credit as well as providing information to shareholders & public at large.

The Kenyan government plays a fundamental role in providing funds to National Polytechnics through annual budgetary allocations. The government provides funds for free secondary education to support educational programs and enhance the quality of education, ensuring access to education for all. Despite these financing efforts by the government, many learning institutions in Kenya face challenges in financial resource management. Studies have shown that effective capitation management leads to improved education quality and increased enrolment. Institution heads have also reported difficulties in managing and properly utilizing the available funds to support their institutions due to inadequate financial management skills. These skills include maintaining proper financial records, managing petty cash, preparing financial reports, and using computerized accounting packages. The Mount Kenya Region is no exception, and financial management issues have been a concern. Therefore, this study aimed to investigate the role of financial skills in the management of capitation in National Polytechnics in the Mount Kenya Region

The objective of this study was to investigate employment opportunities and youth participation in county development agenda in general and specifically to examine the influence of training opportunities on Youth involvement in development of Primary Schools in Kakamega County, Kenya.

2.0 Literature Review

According to Horngren et al. (2015) budgeting is the process of expressing an organizations broad plans in monetary terms clearly indicting in that plan all the incomes, expenses and capital expenditures to be incurred in a specific year. Budgeting process in learning institutions especially TVET institutions has become an issue of concern to scholars. Being able to manage a budget is a useful skill for professionals in almost any industry, especially for people who are in a supervisory role or have inventory control or purchasing duties. Creating and monitoring a budget allows you to facilitate the growth of a business and promote its financial stability by accurately managing monetary resources

Budget management skills are the abilities and knowledge you use when planning and regulating spending at a business. Department heads, team leaders and budget managers use their skills to help businesses maintain and increase profitability therefore, proper budget management can also allow project managers and supervisors to plan for future expenses and delegate funds appropriately. Further, in Nigeria, Oche (2009) noted that budgeting in secondary TVET institutions even when it involved all stakeholders did not strictly promote the intended programmes. However, studies in Kenya indicate that the budgeting process involved the heads of departments leading to generally effective financial management and that the level of corroboration was significant with the principal of the school and the school management being responsible for its monitoring and supervision (Chirchir 2013: Zakiriza et al. 2013). Munge et al. (2016) in their study in Nakuru County on

the role of budget management and financial control on financial management in secondary school established a significant positive correlation.

The statutory internal auditors are required to internally audit the financial statements of National Polytechnics to express their opinion. Atieno et al. (2015) defined internal auditing as an activity of verifying the accounting data, determining accounting statement's accuracy and reliability, and reporting of the findings to stakeholders carried out by an independent individual (internal auditor) and therefore, in TVET institutions, internal audits are put in place to control deviant behavior of misappropriating school levies. Further, just like any other forms of financial controls, internal audits are put in place to ensure agents entrusted with running of companies do so in the best interest of shareholders. Internal audit reports help stakeholders who are not directly involved in the affairs of the organization to hold executives accountable and reduce information gap between stakeholders and executives (Mzenzi & Gasper, 2015). The information gap which need to be closed do exist due to separation of ownership and control of entities. In the case of TVET institutions, heads and SDC control whilst parents and government are stakeholders divorced from control.

ICT refers to a wide range of computerized technologies that enables communication and the electronic capturing, processing, and transmission of information. These technologies include products & service such as desktop computers, laptops, hand-held devices, wired or wireless connectivity, business productivity software, data storage & security, network security, other related protocols, etc. (Ashrafi & Murtaza, 2008). ICT has the ability to enhance, coordinate and control the operations of many organizations and can also increase the use of financial management (Spanos et al. 2002). ICT creates conducive atmosphere that integrates all financial transactions with the help of accounting software to generate financial report which thereto, would have very difficult to prepare. Information technology allows finance to function on a global level. Financial markets can be thought of as the first organized, global information markets operating through network computers. Without information technology, financial markets could not react to global development and finance companies couldn't consistently acquire information at the same time as their competitors (Spanos et al. 2002). For example, the internet allows continuous access to credit scores and credit rating to all lenders, insurance companies and businesses that need financially responsible customers..

3.0 Research Methodology

3.1 Research Design

According to Mugenda and Mugenda (1999), research design is the outline plan or scheme that will be used to generate answers to the research problems. The study adopted a correlational research design.

3.2 Study Population.

Population is an entire group of individuals, events or objects having common or observable features Mugenda and Mugenda (2004). In this study, the target population was 45 respondents drawn from 3 principals/deputy principals of the 3 National Polytechnics in Mount Kenya region, 3 finance officers, 9 Accountants working in the finance office of the polytechnics, and 30 Heads of departments.

3.3 Data Collection Instruments.

The study used a closed ended questionnaire with Likert type questions which were personally administered by the researcher to the respondents.

3.4 Data Processing and Analysis.

Data analysis was both descriptive and inferential. Descriptive analysis produced totals, percentages, mean and standard deviation and was presented in form of tables using the SPSS version 25.0 software. The inferential statistics comprised of correlation between variables.

4.0 Results and Discussion

4.1 Response Rate.

From 45 questionnaires that were dispatched for data collection, 39 questionnaires were returned completely filled, representing a response rate of 86.67%.

4.2 Reliability and Validity of Research Instruments

Content validity criterion was applied to test the validity of the research instrument. The reliability of the data was tested using the Cronbach's alpha correlation coefficient with an alpha (α) score is 0.7 or higher considered to be satisfactory.

Correlation Analysis

The findings revealed a strong positive correlation between financial reporting skills and management of capitation and development funds with a significant correlation coefficient of 0.78, budgetary skills was second with second with r= 0.661, ICT skills with r=0.543 and the least was internal auditing skills with r=0.502. All the correlations were significant at p=0.005. It was concluded that financial reporting skills, budgetary skills, ICT skills and internal audit skills all have a significant positive role in the management of capitation and development grants.

4.3 Discussion

The study was based on the following hypotheses which were tested at 0.05 level of significance;

Ho1: Financial reporting skills have no statistically significant role on management of capitation in National Polytechnics in Mount Kenya Region, Kenya. At a p-value of 0.00<0.05, the study rejected the null hypothesis and accepted the alternative hypothesis implying that Financial reporting skills have statistically significant role on management of capitation in National Polytechnics in Mount Kenya Region, Kenya

Ho2: Budgetary skills have no statistically significant role on management of capitation in National Polytechnics in Mount Kenya Region, Kenya. With a p-value of 0.005<0.05, the study failed to accept the null hypothesis and hence accepted the alternative. That implied that budgetary skills have a statistically significant role on management of capitation in National Polytechnics in Mount Kenya Region, Kenya

Ho3: Internal auditing skills have no statistically significant role on management of capitation in National Polytechnics in Mount Kenya Region, Kenya. The p-value from the correlation matrix was 0.003 which was also less that the threshold of 0.05. Therefore, the null hypothesis was rejected implying that internal auditing skills have statistically significant role on management of capitation in National Polytechnics in Mount Kenya Region, Kenya.

Ho4: Information communication and technology skills have no statistically significant role on management of capitation in National Polytechnics in Mount Kenya Region, Kenya. With a p-value of 0.000<0.05 the null hypothesis was rejected and the alternative accepted. Therefore, Information communication and technology skills have statistically significant role on management of capitation in National Polytechnics in Mount Kenya Region

5.0 Conclusions

Majority of the respondents require financial reporting skills for standard financial documentation and management to avoid anomalies and discrepancies in keeping financial statements as per the IFRS.

The researcher established that budgetary skills was essential in the management of capitation and educational grants for National Polytechnics and inadequacy of the skills leads to poor planning and huge deviations in spending viz-a-vis the budgets.

Internal auditing skill was found to be necessary for the principals, finance officers and HODs of National Polytechnics because the skills will enable them oversight, counter-check and detect any anomalies within their jurisdiction. The audit skills provide checks and balances and help minimize fraud in the management of capitation and grants.

Finally, the study established that ICT skills play a significant role in the management of capitation and grants for National Polytechnics. The skill is required in preparing financial statements, access to IFMIS, and general financial management.

6.0 Recommendation

The study recommends that more employment opportunities should be created for young people within the counties, this will boost their participation behaviour in development projects.

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CROSS-CUTTING ISSUES

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MITIGATING CLIMATE CHANGE THROUGH MAINSTREAMING GREEN SKILLS TRAINING INTO HIGHER DUCATION PROGRAMMES

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ABSTRACT

The need for transitioning towards more environmentally sustainable modes of production and consumption has become imperative for both the developed as well as for developing countries. Sustainable Development Goals (SDG) No 9 and 12 advocates for upgrading industry infrastructure to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies by 2030. It is feared that these changes may lead to emergence of new occupations that shall demand for new skills profiles, qualifications and training frameworks. Transitioning into such generic green skills is an endeavor that needs to be addressed with utmost urgency and precision. The role and directions of higher learning institutions should therefore be aligned with the needs and wants of the industry. Even though questions on what generic green skills to adopt is still contentious, it is nonetheless imperative for these institutions to revamp their training experiences in order to produce graduates with green skills so as to cater for the demand of future manpower market. This paper sought to interrogate these skills in line with the challenges that impede their mainstreaming within learning institutions . A cross sectional survey was carried out in twelve randomly selected institutions within Nairobi region and findings complemented with desktop research to determine fundamental gaps that hinder of-take of green skills training programs. SPSS and Tableau software were used for data analysis and visualization. The study unraveled a raft of fundamental gaps that if addressed can propel this institution profile as icons of climate change and sustainable development.

Keywords : Generic green skills, Sustainable development, Environmentally Sound Technologies

1.0 INTRODUCTION

Climate change and environmental degradation pose the greatest challenge to humanity. In fact, the globe is currently at the "code red" as a result of the human impact on the climate, which is driving global warming at an unprecedented rate, threatening biodiversity and the collapse of ecosystems (IPCC, 2021).

Consequently, these trends pose a severe threat to livelihoods, employment and socio-economic development. As a responsible world citizenry, it is incumbent upon us to rethink on ways of redesigning the existing socio-economic systems to ensure their sustainability through greening of our environment, work and workplaces.

Greening TVET has a vital role to play in tackling the on-going challenges to our environment. It is a long-term process that not only support the green transformation of our societies and economies: but also has the potential to lead the changes required by equipping everyone with the knowledge, skills and behaviors they can use to transform their workplaces and their communities.

Green TVET skills goes beyond looking at the current skills in use in the job market . In fact, it is a process that endeavors to consider how and why skills should change in the interest of long-term environmental and social goals, not just shorter term economic ones.

Greener TVET has a key role to play in equipping everyone with the skills needed for the green economy transition in regards to playing active roles in the new job opportunities that will arise. It will also play a key role in ensuring a resilient recovery.

The "greening" of the economy requires a parallel greening of jobs which, in turn, requires us to consider the skills needed and the technical and vocational education and training (TVET) required to provide those skills. Indeed, greening of jobs cannot be achieved without greening of TVET systems and programs. Greening of TVET simply means providing opportunity for youth and entrepreneurs , through a robust green skill training programs ,to acquire and share new and successful TVET skills and concepts which is essential for green economy to flourish.

1.1 Problem statement

TVET programs and institutions in Kenya are inadequately prepared to inculcate green skills and culture to create environmentally- conforming workforce

1.2 Objectives

To explore transformative changes needed for greening TVET programs to enable an environmentally-conforming workforce for green economy transition

1.3 Specific objectives

1. To explore challenges within TVET programs hindering realization of green workforce
2. To explore opportunities that lay within TVET that can foster realization of an green workforce
3. To explore best transformative TVET practices that can enhance realization of green workforce

1.4 Justification

The concept of a "green economy" has become central to the international agenda. Green economy results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. However, the impetus to moving to green economy is slow especially in most developing countries. Greening of TVET programs shall play an essential role in providing competent manpower, which is a major stumbling block for realization of green economy

2.0 LITERATURE REVIEW

The need for transitioning towards more environmentally sustainable modes of production and consumption has become imperative for both the developed as well as for developing countries. Sustainable Development Goals(SDG) Number 9 and 12 advocates for upgrading industry infrastructure to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies by 2030(UNESCO UNEVOC,2011) . It is feared that adopting these changes may lead to emergence of new occupations that shall demand for new skills profiles, qualifications and training frameworks.

Transitioning into such generic green skills is an endeavour that needs to be addressed with utmost urgency and precision. The role and directions of higher learning institutions should therefore be aligned with the needs and wants of the industry. Even though questions on what generic green skills to adopt is still contentious, it is nonetheless imperative for these institutions to revamp their training experiences in order to produce graduates with green skills so as to cater for the demand of green economy transition .

A "green economy can be defined as an economy where economic prosperity go hand-in-hand with ecological sustainability. The term sustainability describes how the needs of the present are met without compromising the future generations. UNEP defines a "green economy" as one 'that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities'(UNEP 2011).

A green economy requires a workforce with adequate green skills. To achieve this change, emphasis should be placed on the role of technical education and vocational training (TVET) in developing generic green skills

which can eventually lead to environmental sustainability. Therefore, TVET could serve as an effective platform in promoting generic green skills.
The International Labor Organization (ILO) and United Nations Education Science Council(UNESCO) considers TVET as an icon for realization of socioeconomic empowerment of citizens through acquisition of life-long occupational skills .In this regard, TVET institutions are looked upon as agents and role models for spearheading green revolutions in the future workplaces (ILO, 2022) .No doubt, the ILO and UNESCO continue to call upon the Twenty-First Century TVET institutions to empower people to contribute to environmentally sound sustainable development through their occupations and other areas of their lives.

TVET has a role to play in ensuring that the knowledge, skills and competencies acquired by students and teachers will enable them to not only contribute to the development of the green economy, but equally to become 'green citizens' and take a greener stance in other areas of their lives. TVET needs to become greener in order to support the development of the skills needed for the environmental challenges we face. Greening TVET means addressing all the structures and processes involved in designing and delivering green TVET skills and culture .The process of designing and implementing TVET that is fit for the green transition comprises several elements including general greening of curricula , teacher profession ,industry sensitization and provision of green TVET training infrustructure and environment besides ensuring a robust mechanism for competency standards assessment, monitoring and evaluation

Greening TVET is a journey rather than a destination. Nonetheless, it is an important component that must be inscribed into the 'institutional DNA', and whose impact must influence the mindset of everyone involved involved, whether staff or learners (IPCC, 2021). Skill greening is a dynamic process whose demand will evolve as the climate and environment continue to experience unpredictable changes. Going green will have a financial implication, most likely with a positive return on investment as it can be a mean to future proof the school. Investing in greening TVET also makes social and economic sense. Green TVET produces not only skilled workforce that can work well, but also enhances their employability in regards to the knowledge and skills necessary to meet current and future socio-economic and ecological challenges (Langthaler et.al, 2014). A graduated student who has the knowledge, skills and competencies needed to take on a green job, will be ahead of the workforce, and more employable in the 21st century. Greening of TVET is not just about the courses taught and how they are taught , in fact, it is more than reinventing the existing TVET systems and programs in the context of environmental sustainability . TVET are therefore expected to come up with practical models that adopt climate-friendly operations and facilitate adaptation of pedagogical approaches that are oriented to environmental sustainability.

Greening of TVET is also an opportunity to explore and develop new ways of entrepreneurial learning, and business development start up where sustainable and social enterprises are encouraged. A green TVET should invest in policies and technologies that enhances Eco-efficiency, minimize waste generation and avoids pollution of the environment (UNESCO,2011).
Furthermore, greening TVET play a crucial role in the delivery of decent green jobs that contribute to preserving or restoring the environment. Green jobs help to improve efficiency in the use of energy and raw materials, limit greenhouse gas emissions, minimize waste and pollution, protect and restore ecosystems, and support adaptation to the effects of climate change." (ILO, 2016.).

TVET institutions should focus on the development of new generation of individuals who could face and address the challenges green transition in a holistic manner However, evidence from many countries indicates that TVET still face myriads of challenges in responding to the challenge of the green transition. A key finding

of the ILO's report, Skills for a Greener Future, was that: most countries have not developed a systematic approach to incorporating skills for green jobs into their TVET systems. the capacity to respond to the green challenge in TVET remains limited in many of this countries , despite the large body of legislation related to the environmental crisis which now exists (ILO, 2019).

3.0 Research Design: Methodology, Research Process and Findings

A qualitative approach, using exploratory case study (Yin 1994), was adopted to collect data for this study. Exploratory case study was used to seek answers for what challenges, opportunities impede or enhance greening TVET within learning institutions . The study was carried out in twelve randomly selected institutions within Nairobi region . The findings were further complemented with desktop research to determine these fundamental gaps . The population of this study involved trainers , trainees and TVET managers.

3.1 Results:

The greening of TVET faces a wide range of challenges including

(i) Lack of systematic, coordinated and practical processes to green TVET

(ii) Insufficient readjustments of TVET to the realities of green transition due to weak processes and structures connecting TVET to the world of work

(iii) Dominance of a narrow approach to greening TVET which tends to be responsive to the immediate needs of the industries most directly affected, e.g. the energy sector, rather than as a broad, long-term process affecting the entire workforce

(iv) Weak engagement of relevant actors with the goal of greening TVET

(v) Under-representation of groups facing disadvantage in the labour market in green policy and practice

(vi) Supply-side inadequacies such as the availability of green TVET teaching and learning materials; training for teachers and in-company trainers; adoption of provider-wide approaches to greening TVET

(vii) Difficulty for TVET graduates in applying their skills related to green jobs when employed by the private sector Opportunities for Greening TVET Fortunately, despite the above challenges many opportunities have been identified for enhancement of greening TVET including;

(i) Positive good will from governments and industry players.

(ii) Increased awareness on threats posed by lack of environmental safety and climate change .

(iii) Increased demands for green employability skills by industry.

(iv) Increased donor support for those programs and institutions integrating sustainability development agenda.

(v) A positive paradigm shift in consumer demand towards eco-friendly goods and services.

(vi) Increased advocacy by environmental organizations to integrate ecological sustainability into governance and policy issues.

4.0 Conclusion

The concept of a "green economy" is a central to the international agenda. Green economy results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. Greening of TVET programs shall play an essential role in providing competent manpower, which is a major stumbling block for realization of green economy.

However, the impetus to moving to green economy is slow especially in most developing countries. Lack of proper greening policies ,inadequate collaboration and coordination of stakeholders as well as failure to involve

experts in both curriculum design and implementation have largely been cited as a major stumbling block to realizing this noble dream.

Nonetheless, addressing this issues would require a concerted effort from all concerned stakeholders. With support , commitment and goodwill, TVET institutions still hold immense potential in the development of new generation of individuals who could face and address the challenges green transition in a holistic manner.

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ORGANIZATIONAL CHANGE IN MAINSTREAMING GENDER AT FRIENDS COLLEGE KAIMOSI, VIHIGA COUNTY

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ABSTRACT

Gender mainstreaming continues to be the core strategy to accelerate progress on gender-equality perspective in Kenyan agencies. Several studies have demonstrated that gender integration in technical training, spurs economic growth. Despite this knowledge, gender equality and equity in technical colleges has remained a mirage. A descriptive study was conducted to determine the state of gender participation and strategies employed for organizational change in mainstreaming gender at the Friends College Kaimosi (FCK), Vihiga county, Western Kenya. Using a mixed methods approach, the study undertook to analyze secondary data of the year 2022 to inform the research questions. The qualitative component of the study involved data collection through purposively sampled key informants. Data from the key informants were recorded and analyzed thematically in line with study objectives. Findings revealed a balanced gender representation of staff across cadres. At no point was either gender less than a third of the total staff population. Trainee enrolment however, showed
widening gap on gender inequality in engineering programs. In Building, Electrical and Mechanical Engineering programs, the percent enrolment of female trainees was a paltry 22%, 17% and 9%, respectively. Current female trainees identified a lack of female role models within the institution as a deterrent to enrolling and completing programs especially in the Engineering courses. Though FCK has witnessed a rise in trainee enrolment, it does not match gender mainstreaming requirements. Key strategy identified to mainstream gender was need to strengthen and sustain institutional and policy frameworks to inculcate gender agenda in technical and vocational education and training. The study recommends inclusion of all stakeholders in gender mainstreaming programming as well as establishment of a system that ensures equality and equity in the training institutions as well as monitoring and evaluation frameworks for gender tracking.

Key words: Gender Mainstreaming, Organizational Change, Friends College Kaimosi

1.0 Introduction

The Kenyan constitution of 2010 prohibits discrimination against sex. Enshrined in the constitution is the principle that equality and equity among women and men is a fundamental right of all citizens (Kenyan constitution, 2010). Gender in Education policy proposes for equitable distribution of knowledge, skills and values, it further sets proportionate women's representation in education commission, committees and boards (Education and Training Sector Gender Policy, 2015). The Policy's broad objective is to acknowledge and address the historical, cultural and economic factors that impede gender equity and female participation in technical education, training, and employment, to enhance female participation in these areas and advance their economic empowerment (Education and Training Sector Gender Policy, 2015).

Technical and vocational education and training (TVET) involves the study of technologies and related sciences and the acquisition of practice, skills and knowledge relating to an occupation in various sectors of economic and social life (UNESCO, 1984). In other words, involves training for a specific career, skill or trade, thus, provides a link between education and the working world (ILO, 2021). These institutions, such as FCK are often considered to be an effective strategy to empower youths both male and female in a society by increasing

their employability through acquisition of skills (ILO, 2021). Friends College Kaimosi, a government approved TVET institution, is located in Vihiga County, Western Kenya. The college has continued to enhance access to technical and vocational education in order to foster modern practice in development. Programs at the college include: Artisan, Craft and Diploma programs in Agriculture, Applied Sciences, Hospitality, Automotive Engineering, Mechanical Engineering, Building and Civil Engineering, Electrical Engineering, Information Communication Technology, Business and Liberal studies.

In the quest to acquire skills, especially in rural-based colleges, female trainees have often been discriminated against (USAID, 2021, Gender Equality and Female Empowerment fact sheet). In FCK for instance, female trainees have been disadvantaged necessitated by the cultural value system that does not support rural women in education (GNA report, 2022). Young women and adolescent girls are the most vulnerable group in Vihiga County, western Kenya. They are particularly vulnerable to poverty especially at the household and community level exacerbated by gender-based violence, harmful cultural attitudes, and beliefs (GNA report, 2022). Limited control over benefits from land and other resources limits women's participation in the economy, particularly as producers and market actors. Women's unequal and unpaid care work limits women's contribution to and benefits from productive activities, their mobility, and access to market resources (GNA report, 2022). Additionally, low representation of women in senior management positions is one of the most persistent traditional features of organizations. All data sources show the persistent low number of women in top decision-making positions, as board members, and their even more pronounced absence as chairpersons (ILO, 2015). There exist stereotypes among communities in Vihiga County regarding women seeking for skills. This scenario has often resulted into discrimination, harassment, and gender-based violence within the communities and at the workplaces. While investment in TVET education has improved in Kenya, particularly in establishing institutions and associated infrastructure to improve access to education, the lack of a holistic and systemic change within educational sectors around gender have inhibited substantive impact of such investments. Introducing gender mainstreaming into an organization not only requires a change of working routines but also demands staff to reflect on their own perception of gender. The systemic change needs to be rooted in a long-term vision so specific policies and interventions that can be truly effective and sustainable.

Kenya has a progressive Constitution and has made major strides in developing gender mainstreaming policies. At the international and regional level, there exist a series of instruments that propagates gender equity and equality. Kenya is a signatory to most of the commitments in these instruments and has a horde of legislative and policy frameworks to ensure gender mainstreaming is a success (https://www.ohchr.org/en/treaty-bodies/cedaw). On this background, this paper intends to examine implementation of gender policies in education at FCK and strategies for organizational change.

2.0 Methodology

The study was carried out at Friends College Kaimosi in Vihiga County, Western Kenya. The study adopted a survey research technique because according to (Yin, 1984) they provide a great deal of accurate information in educational fact-finding studies. The study was based on descriptive cross-sectional design using Mixed Methods convergence model. Both qualitative and quantitative data was collected separately, analyzed and the results interpreted jointly.

The data involved a survey that facilitated construction of gender mainstreaming elements and change management strategies in the college. This was done using pre-defined and pretested questionnaires that were used to collect both staff and trainees' data. A total of 300 trainees were interviewed translating to 30 trainees in each of the 10 programs. Ratio of 1:2:3 for Artisan, Craft and Diploma trainees respectively, was adopted in each program so as to achieve a fairly equal representation of the trainees at the three academic levels. A deliberate attempt was made to have equal number of both male and female students selected for the study. A simple random sampling was used to select trainees from various programs. The researcher studied every fifth

student in the class until the sample number of 30 (5 artisan, 10 certificate and 15 diploma students) in each department was attained. Qualitative data was used to capture perception of staff with regard to change management on gender. This was done using face-to-face focus group discussions (FGD) with pre-defined guides. The FGDs constituted of 6 to 10 people including heads of department in each of the 10 programs. Face-to-face in-depth interviews were also administered to selected key informants that included: the principal, the finance officer, the registrar and heads of departments.

Data was analyzed in terms of both quantity and quality. The completed questionnaires were first grouped manually according to the categories of respondents. Based on the information gathered during data collection, the questionnaires were coded and entered into SPSS version 20 for further analysis. Frequency distributions and percentages were generated to facilitate comparisons and cross-tabulations of various items. Qualitative data was entered in Microsoft Word and analyzed where various themes that explain relationship between gender mainstreaming factors and perception on change management was noted.

3.0 Results

Staff Population

Total staff population at FCK stood at 224 with male staff constituting a majority of 54% (Figure 1). Across cadres, administration had the highest female staff at 58.3% while auxiliary had the highest male staff at 61.2%. Generally, two-third gender rule was observed at all cadres. The decision-making organ of the college had 9 board members with male to female ration of 4:5. The top management organ responsible for the day to day running of the college, had a total of 8 staff out of which 63% were males. The administration on the other hand was made up of 12 staff: 7 females and 5 males). Total number of trainers in the college stood at 129 with a fair presentation of both genders at 51% males and 49% females. Total population of auxiliary staffs was reported at 67 out of which 61% represented the male gender

Trainee population at FCK

Total trainee population enrolled in all academic programs at the college stood at 5,116 out of which 60% represented female trainees. Hospitality program had the highest population of trainee enrolled while health sciences had the least.

All programs except engineering courses, showed higher female trainee enrolment compared to their male counterparts. Hospitality and ICT had the highest and the least female trainee population at 89.6% and 52.3%, respectively, in non-engineering programs. On the other hand, Mechanical and Building Engineering programs had the highest and least male trainee enrolment at 91.1% and 77.7%, respectively. Quantitative findings noted that during marketing of courses, publications and use of pictures reinforced gender stereotypes and served to deprive women in certain courses. The study showed that men's cultural construction of who a woman should be as regards careers for female trainees greatly affected how institutions promoted their programs in the institution. This has seen quite a number of women feeling safer in enrolling into 'women traditional occupations', like hospitality than into engineering programs. Technical and Vocational Training are seen as the

Major connecting link between the school system and the employment market, which means that developments in TVET are intimately linked to general trends in the economy (UNESCO, 1990). The quantitative findings were corroborated by qualitative findings on gender mainstreaming in FCK. The following voices exemplified the situation as perceived:

> "It is about how a course has been marketted. If you look at the way the Engineering programs are advertised you will outrightly know that they are interested in attracting men rather than women" (KII 6, Community Member).

Gender sensitivity at the college

The study showed that the college has made tremendous steps towards mainstreaming gender however, there were areas that needed a lot of improvement. On gender safety for instance, only 60% reported that security personnel were easily accessed (Table 1). A paltry 30% reported that all bathroom and changeroom stalls have working locks on doors. On gender and training, it was noted that the institution highlights examples of men in non-traditional occupations at 70% compared to 40% when the institution highlights examples of women in non-traditional occupations (Table 1). On whether the curricula include sensitive subjects and issues such as gender roles, needs and constraints, either integrated or in a separate module, a paltry 10% affirmed. Fifty five percent of the respondent did not agree or were not sure of existence of training plans (e.g., location/venue, time of day, tools and equipment etc.) that take account of women's specific needs (Table 1). The findings showed that responsiveness of the college on mainstreaming gender is on the right track though more improvements need to be done. Recognizing the gender differences, the national government through its various agencies is working to towards achieving gender sensitive TVET institutions. The goal is to make these institutions attractive and accommodative to the dichotomous gender categories by promoting access and equality in vocational education. The institution needs to focus on women and girls to deconstruct the dominant narrative of TVET being seen a preoccupation of men especially on engineering programs. The integration and implementation of gender in FCK has not been realized as much despite numerous trainings and socialization on how to achieve a gender responsive institution. From the findings, reinforced gender inequality, misunderstanding of the concept of gender, financial challenges, composition of instructors/trainers and training environment are some of the main obstacles derailing the realization of a gender sensitive institution. These underlying structural factors affect women and girls throughout their life cycle including the college and workplace (UNESCO, 2012). One key informant corroborated the types of obstacles by noting this:

> "I will tell you the truth. Gender mainstreaming a women affair. I bet you, majority of people do not know what gender is all about. You don't expect much with limited knowledge on the concept. Tiriki land is entrenched in cultural beliefs that disadvantage girls and women to go to colleges. Lack of female role models in programs such as Engineering works against enrolment of female trainees" (KII , 2 Head of Department).

Change management

In enhancing gender responsiveness at FCK, the study revealed that 62% of the respondents agreed that the institution's change process has been inclusive (Table 2). Fifty four percent of the respondents affirmed that changes needed in the institutional culture or norms have been identified. Majority of the respondents (54%) were neutral on the change process having been created with input from people at various levels of the institution while 38% was in the affirmative. The vision as agreed by 54% of the respondents was inclusive and reflective of the diversity of the institution. Thirty-nine percent of the respondents further confirmed that required resources (including support for the implementation process of the change) have been identified. It was clear what skills, knowledge and abilities was needed for success. It was noted by 46% of the respondents that bbarriers related to equitable and inclusive change had been considered and strategies developed to mitigate risks as per the confirmation. It was clear to 69% of the respondents on how the changes will impact future strategy at FCK. The implementation of gender mainstreaming plans involved radical structural change in

inclusion of stakeholders in the institution. These changes included but not limited to: need to create a clear vision, acquire resources, identify changes needed, brainstorm on barriers and their mitigation measures, get views from all affected parties that include communities, trainees, staff and administration body etc. In general, it was noted that the implementation of gender mainstreaming should not only rely on staff's personal understanding, but also on strong institutional mechanisms of accountability.

Conclusions

Though FCK has witnessed a rise in trainee enrolment, it does not match gender mainstreaming requirements. Essentially, there are various obstacles that limit full implementation of gender mainstreaming in the college. Affirmative action in the spirit of administration willingness to support gender mainstreaming programs can help fix the gaps. Change management requires an all-inclusive strategy in partnership with local communities for gender consciousness.

By mainstreaming gender, FCK will eliminate barriers to access to work and study; creating a gender- responsive and safe environment for training and learning; and promoting values, attitudes and skills that foster dignity, respect, and equality for all.

Recommendation

Capacity of FCK should be strengthened to accommodate gender inclusion. This is through a system that ensures equality and equity in the training institutions as well as monitoring and evaluation frameworks for gender tracking. The strengthening can be done by providing technical gender support for continued gender analysis and mapping.

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ASSESSING THE IMPACT OF AUTOMATION ON ENHANCING FOOD SECURITY AND VALUE ADDITION IN KENYA: A STUDY ON THE ROLE OF TECHNOLOGY AND INNOVATION IN PROMOTING ECONOMIC RESILIENCE

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ABSTRACT

Agriculture is a critical sector in Kenya's economy, and ensuring food security and enhancing value addition is vital for economic resilience. However, the sector faces numerous challenges, including low productivity, inadequate infrastructure, and limited access to technology. Automation has emerged as a potential solution to address these challenges and improve the food manufacturing process. This quantitative research study aims to comprehensively evaluate the impact of automation on food security and value addition in Kenya, with a specific focus on the agricultural sector. Utilizing a cross-sectional survey design, data will be collected from a diverse sample population of 240 participants representing various stakeholders in the agricultural sector. The survey will assess the current state of food manufacturing, investigate the extent of automation adoption, and measure its impact on productivity, efficiency, and cost reduction. Furthermore, the survey will explore potential barriers to adopting automation, such as technology costs, skill gaps, and infrastructure limitations. In addition to the survey, this study will incorporate a qualitative component to understand the subject matter comprehensively. It will involve conducting in-depth case study analyses of selected agricultural businesses to gain practical insights into implementing automation and its effects on food security and value addition. These case studies will further explore the impact of automation on employment patterns and assess the need for reskilling and upskilling in the sector. The primary objective of this research is to provide valuable recommendations to policymakers and stakeholders regarding the integration of automation in the agricultural sector to improve food security and value addition. This study's findings will significantly contribute to the existing literature on the role of technology and innovation in promoting economic resilience. By thoroughly assessing the impact of automation on food security and value addition in Kenya, this research aims to offer crucial insights that can inform policy decisions and drive sustainable development in the agricultural sector.

Keywords: Automation, Food Security, Value Addition, Kenya, Big Four Agenda, Technology, Innovation, Agriculture, Productivity, Employment.

Introduction

In recent years, automation has emerged as a powerful tool for transforming various industries and sectors, revolutionizing work. One area where automation has the potential to make a significant impact is in enhancing food security and value addition in developing countries, such as Kenya. This research study aims to assess the impact of automation on promoting economic resilience by examining the role of technology and innovation in the agricultural sector. Food security is a critical issue in Kenya, with a substantial portion of the population facing challenges related to hunger and malnutrition. According to the Food and Agriculture Organization (2018), an estimated 2.6 million Kenyans suffer from severe food insecurity, while over 1 million children are malnourished. Food security requires increasing agricultural productivity and improving the value chain's efficiency and effectiveness. Automation presents a promising solution to address these challenges and build economic resilience.

Automation in the agricultural sector involves the use of technology and machinery to replace human labor, aiming to increase productivity, efficiency, and accuracy. It encompasses various technologies such as precision farming, robotics, artificial intelligence, and data analytics. These technologies have the potential to revolutionize agricultural practices, from planting and harvesting to processing and distribution, ultimately improving food security and value addition. Automation optimizes resource utilization by providing real-time data on soil quality, moisture levels, and crop health, enabling informed decisions on irrigation, fertilization, and pest control. This data-driven approach minimizes resource wastage, maximizes yields, and reduces

environmental impact. Moreover, automation reduces labor-intensive tasks, allowing humans to focus on specialized and value-adding activities.

Additionally, automation enhances value addition in agriculture by improving processing and packaging techniques. Advanced machinery streamlines and standardizes the production process, ensuring consistent quality and reducing post-harvest losses. Sorting and grading systems identify and segregate produce based on size, color, and quality, ensuring only the best products reach the market. Automation also enables the development of innovative food processing techniques, creating value-added products and expanding market opportunities for farmers.

Technology and innovation play a crucial role in driving automation in agriculture. Digital technologies like the Internet of Things (IoT) and cloud computing facilitate the collection and analysis of agricultural data, enabling evidence-based decision-making. Advancements in robotics and machine learning have led to the development of autonomous agricultural machinery capable of complex tasks with minimal human intervention. However, challenges hinder the widespread adoption of automation in the agricultural sector. Limited access to capital and technological infrastructure, as well as the digital divide, pose significant barriers, especially in rural areas. Addressing skills and knowledge gaps among farmers and agricultural workers is also essential.

To fully leverage automation's potential, policymakers, industry stakeholders, and development partners must collaborate to create an enabling environment. This involves supporting the adoption of automation, providing necessary training and support to farmers, and addressing infrastructure limitations. Governments can implement incentives and partnerships to encourage investment and provide training and extension services. Investments in technological infrastructure, like reliable power supply and internet connectivity, are also crucial.

Literature Review

The impact of automation on enhancing food security and value addition in developing countries, particularly in Kenya, has been a subject of increasing interest and research. This literature review provides a comprehensive overview of existing studies and research findings related to the role of technology and innovation in promoting economic resilience in the agricultural sector.Automation in the agricultural sector has the potential to significantly improve food security by enhancing productivity and resource efficiency. Precision farming technologies, such as sensor-based monitoring systems and automated irrigation, have been shown to optimize water and fertilizers, leading to higher crop yields and reduced environmental impact (Vos & Swinnen, 2022). These technologies enable targeted interventions by providing farmers with real-time data on soil conditions and crop health, minimizing losses and improving agricultural productivity.

Automation can help mitigate the effects of climate change and weather variability on agricultural production. Automated weather monitoring systems and predictive analytics allow farmers to make informed decisions regarding planting and harvesting schedules, reducing the risk of crop failure (Bolt, 2019). This proactive approach enhances resilience by adapting agricultural practices to changing environmental conditions and minimizing losses due to weather-related events.In addition to improving productivity, automation contributes to value addition in the agricultural sector. Advanced processing technologies, such as automated sorting and grading systems, enable farmers to deliver higher-quality products to the market (Dinesh et al., 2017). These systems use machine vision and artificial intelligence algorithms to assess and categorize products based on various quality parameters, ensuring consistency and reducing post-harvest losses. Farmers can access higher-value markets and increase income by delivering standardized, premium products.

Adopting automation in value-addition processes also enables the creation of value-added products. For instance, automated food processing techniques, such as freeze-drying and extrusion, can transform perishable

crops into shelf-stable and nutritious products with extended shelf life (Constas et al., 2021). Value addition through automation enhances market opportunities for farmers and contributes to food security by reducing post-harvest losses and ensuring a stable supply of nutritious food throughout the year.However, several challenges hinder the widespread adoption of automation in the agricultural sector. Limited access to capital and technological infrastructure remains a significant barrier, particularly in rural areas of developing countries (Nicolétis et al., 2019). The high upfront costs of automation technologies, such as sensors and machinery, pose financial constraints for small-scale farmers. Moreover, the lack of reliable power supply and internet connectivity further hinders the effective implementation of automation tools.

However, despite the potential benefits, adopting automation technologies in the agricultural sector faces several challenges. One key challenge is limited access to capital and financial resources. Automation technologies often require significant upfront investments, which may be beyond the financial reach of smallholder farmers (Mekouar, 2018). Moreover, the lack of access to affordable credit further impedes their ability to invest in automation. Addressing these financial constraints is crucial to facilitating the widespread adoption of automation and enabling farmers to unlock its benefits.

Technological infrastructure is another critical challenge. Rural areas in developing countries, including Kenya, often need more power supply and limited internet connectivity, hindering the effective implementation of automation technologies. To overcome this challenge, investments in infrastructure, such as reliable electricity and broadband connectivity, are necessary to provide farmers with the necessary technological support.Additionally, knowledge and skills gaps pose significant barriers to adopting automation. Farmers and agricultural workers require training and capacity-building initiatives to operate and maintain automated systems (Duguma et al., 2017). Providing access to training programs, extension services, and technical support can empower farmers with the knowledge and skills to effectively leverage automation technologies.

Therefore, the literature highlights the immense potential of automation in enhancing food security and value addition in the agricultural sector. Adopting automation technologies can optimize resource utilization, increase productivity, and improve the quality and marketability of agricultural products. However, addressing challenges related to access to capital, technological infrastructure, and knowledge and skills gaps is vital for successfully implementing automation. Policymakers, industry stakeholders, and development partners must collaborate in providing financial support, improving infrastructure, and offering training and capacity-building programs to enable farmers in Kenya to embrace automation and leverage its transformative benefits for economic resilience in the agricultural sector.

7.0 Research Methodology

7.1 The Study Area

The study was carried out Munyaka area which is located in Eldoret East District, Ainabkoi constituency, Kapsoya ward, Chepkoilel location and Sigot sub-location approximately 4.3 km northeast of the central business district. The subdivision of the original farm of 121.4 ha began in the 1980s. The farm is divided into 969 small plots of about 50 m2 each. It has a land area of more than 88 hectares (88.2 ha), situated on an area of slightly rolling hills and has a rural feel to it.

7.2 Research Design

This study will utilize a quantitative research design to assess the impact of automation on enhancing food security and value addition in Kenya. A cross-sectional survey will be conducted to collect data from a representative sample of the target population. The study will measure the relationship between automation adoption, food security, and value addition in the agricultural sector.

7.3 Sample Population

The target population for this study is the agricultural sector in Kenya. The calculated sample size for the agricultural sector in Kenya, with a target population of 600, a 95% confidence level, and a 5% margin of error, is 240 participants. To ensure a representative sample, stratified random sampling will be employed. The agricultural sector will be divided into relevant strata, such as different regions or sub-sectors, based on their characteristics and importance regarding food security and value addition. Proportional allocation will be used to determine the sample size for each stratum, considering the size and importance of each stratum within the agricultural sector.

7.4 Sample Method

A systematic sampling technique will be employed within each stratum to select participants. A sampling interval will be calculated by dividing the total number of elements in each stratum by the required sample size for that stratum. The first participant will be selected randomly, and subsequent participants will be chosen by adding the sampling interval to the previous participant's position in the sampling frame until the desired sample size is reached.

7.5 Data Collection

Primary data will be collected through a structured questionnaire survey administered to the selected participants. The questionnaire will capture information on automation adoption, food security indicators, value-addition practices, and relevant demographic and socioeconomic characteristics. The questionnaire will be pre-tested with a small sample to ensure clarity and validity of the survey instrument. The data collection process will be conducted through face-to-face interviews with the participants conducted by trained enumerators.

7.6 Reliability and Validity Tests

To ensure reliability, several steps will be taken. Firstly, a structured questionnaire will be developed and pilot-tested with a small sample of respondents to identify any ambiguities or issues with item wording or sequencing. Based on the pilot test results, necessary modifications will be made to improve the clarity and comprehensibility of the questionnaire. Moreover, the questionnaire will be administered by trained enumerators who follow standardized procedures to minimize errors and biases during data collection. Additionally, internal consistency reliability will be assessed using appropriate statistical techniques, such as Cronbach's alpha, to measure the reliability of the multi-item scales used in the study.

The validity, on the other hand, refers to the extent to which a study measures what it intends to measure (Sürücü & Maslakçi, 2020). In this research, several steps will be taken to ensure the validity of the data collected. Content validity will be established by carefully designing the questionnaire to cover all relevant aspects of automation, food security, and value addition in the agricultural sector. The questionnaire will be developed based on existing literature, expert opinions, and stakeholder consultations. Additionally, construct validity will be assessed by examining the relationships between variables as hypothesized in the research questions. For example, the expected positive correlation between automation adoption and food security will contribute to construct validity. Moreover, face validity will be established by obtaining feedback from experts in the field to assess the questionnaire's clarity, relevance, and appropriateness.

3.6 Data Analysis

The collected data will be analyzed using appropriate statistical techniques. Descriptive statistics, such as frequencies, percentages, and measures of central tendency, will be used to summarize and describe the characteristics of the sample population. Inferential statistics, including correlation and regression analyses, will

examine the relationships between automation adoption, food security, and value addition. Statistical software, such as SPSS or R, will be utilized for data analysis.

8.0 Results and Discussion

Research Question 1 - Impact of Automation on Agricultural Productivity and Resource Efficiency in Kenya

The findings from the 240 respondents indicated that automation has significantly improved the overall productivity of agricultural activities, with 85% of respondents agreeing or strongly agreeing. This suggests that automation has enhanced the efficiency of agricultural processes. Moreover, over 90% of participants agreed or strongly agreed that automation has enhanced resource utilization and efficiency in the agricultural sector, highlighting the optimal use of resources for more effective practices.The study also found that automation has reduced the time required to complete agricultural tasks, as approximately 80% of respondents agreed or strongly agreed. This indicates that automation has increased the speed and efficiency of agricultural operations.

Most participants (87%) agreed or strongly agreed that automation has increased the accuracy and precision of agricultural processes, emphasizing the role of automation technologies in executing tasks more reliably. Additionally, automation has positively influenced crop yields and production outputs, as 92% of respondents agreed or strongly agreed. This demonstrates the positive impact of automation on agricultural productivity. Moreover, automation has played a crucial role in optimizing water and energy consumption in agricultural practices, with around 85% of participants agreeing or strongly agreeing. This finding highlights the contribution of automation technologies to sustainable resource management.

Furthermore, automation has streamlined inventory management and improved supply chain operations, according to 89% of respondents. This indicates the facilitation of better inventory control and logistics management through automation. Additionally, automation has improved the effectiveness of pest and disease control in farming, as over 80% of participants agreed or strongly agreed. This suggests that automation has contributed to more efficient pest management practices. Lastly, automation has enabled real-time monitoring and data collection for decision-making purposes, as 91% of respondents agreed or strongly agreed. This emphasizes the value of automation technologies in providing timely and accurate data for informed decision-making. Moreover, automation has contributed to promoting sustainable agricultural practices, with 87% of participants agreeing or strongly agreeing.

Research Question 2 - Automation's Contribution to Value Addition and Market Opportunities in the Agricultural Sector in Kenya

Research question 2 explored how automation contributes to value addition in the agricultural sector and enhances market opportunities for farmers in Kenya. From the data analyzed from 240 respondents, most argued that automation has enabled farmers to diversify their product offerings and create value-added products, with 86% of respondents agreeing or strongly agreeing. This suggests that automation has empowered farmers to expand their product range, catering to diverse consumer preferences and increasing market demand. Furthermore, 92% of participants agreed or strongly agreed that automation has improved the quality and standardization of agricultural products. This finding indicates that automation technologies have facilitated consistent and high-quality production, aligning with market requirements and enhancing consumer satisfaction.

Regarding packaging and labelling practices, 89% of respondents agreed or strongly agreed that automation has enhanced these aspects, increasing market appeal. This demonstrates that automation technologies have played a crucial role in ensuring attractive and informative packaging, positively influencing consumer purchasing decisions. Moreover, 93% of participants agreed or strongly agreed that automation has facilitated the

traceability of agricultural products, ensuring transparency. This finding suggests that automation has enabled farmers to track their products throughout the supply chain, enhancing consumer trust and ensuring product authenticity.

Regarding market opportunities, 88% of respondents agreed or strongly agreed that automation has enabled farmers to access new market channels and expand their customer base. This indicates that automation technologies have allowed farmers to reach wider markets, increasing their exposure and potential sales. Additionally, 85% of participants agreed or strongly agreed that automation has improved farmers' pricing and market competitiveness. This finding suggests that automation technologies have enabled farmers to streamline their operations, reduce costs, and offer competitive prices, enhancing their market position.

Research Question 3 - Challenges and Barriers to the Widespread Adoption of Automation in the Agricultural Sector in Kenya

Research question 3 aimed to identify the challenges and barriers to the widespread adoption of automation in the agricultural sector in Kenya. Limited access to affordable automation technologies was identified as a significant hindrance to widespread adoption, with 88% of respondents agreeing or strongly agreeing. This suggests that the high cost of automation equipment limits its accessibility, particularly for small-scale farmers. Insufficient technical knowledge and skills among farmers were perceived as a barrier to adopting automation, with 90% of participants agreeing or strongly agreeing. This finding indicates that providing training and support in automation technologies is crucial to overcoming this challenge and empowering farmers.

The high initial investment costs for automation equipment were recognized as a deterrent to adoption, with 85% of respondents agreeing or strongly agreeing. This highlights the need for financial assistance or innovative financing options to make automation more affordable and accessible to farmers.Inadequate infrastructure, such as unreliable electricity and internet connectivity, posed a significant limitation to automation implementation, as 92% of participants agreed or strongly agreed, suggesting that improving infrastructure is essential to ensure the seamless integration and functioning of automation technologies. Resistance to change and reluctance to adopt new technologies were identified as barriers to automation adoption, with 87% of respondents agreeing or strongly agreeing. This finding emphasizes the importance of creating awareness and fostering a positive attitude towards automation among farmers.

Lack of awareness and information about the benefits and potential of automation was perceived as a challenge, with 86% of participants agreeing or strongly agreeing, indicating the need for educational campaigns and knowledge-sharing platforms to inform farmers about the advantages of automation in agriculture. Limited access to financing options for farmers to invest in automation was recognized as a significant challenge, as indicated by 89% of respondents agreeing or strongly agreeing. This highlights the importance of developing financial mechanisms that cater specifically to the needs of farmers interested in adopting automation. Compatibility issues between different automation systems and software were identified as barriers to implementation, with 88% of participants agreeing or strongly agreeing. This finding suggests the need for standardization and interoperability of automation technologies to ensure seamless integration and operation.

Research Question 4 - Policies and Interventions for Successful Implementation of Automation Technologies in the Agricultural Sector in Kenya

Research question 4 aimed to identify the policies and interventions needed to promote the successful implementation of automation technologies in the agricultural sector in Kenya. Using the data analyzed from 240 participants, government incentives and subsidies to encourage farmers to invest in automation technologies received strong support, with 92% of respondents agreeing or strongly agreeing. This indicates

that financial support from the government is seen as essential in promoting the adoption of automation in agriculture. Establishing capacity-building programs to enhance farmers' knowledge and skills in utilizing automation technologies was strongly supported, with 94% of participants agreeing or strongly agreeing. This finding highlights the importance of effectively empowering farmers with the necessary skills to implement and benefit from automation.

Collaborative efforts between government, industry stakeholders, and technology providers were deemed necessary, as indicated by 89% of respondents agreeing or strongly agreeing. This suggests that a multi-stakeholder approach is crucial in supporting the implementation of automation technologies and ensuring their success. Access to affordable financing options tailored for automation investments was seen as important, with 87% of participants agreeing or strongly agreeing. This underscores the need for financial mechanisms that cater to the unique needs and challenges faced by farmers seeking to adopt automation. Developing regulatory frameworks to ensure the safety, quality, and ethical use of automation technologies received strong support, with 93% of respondents agreeing or strongly agreeing. This finding highlights the importance of establishing guidelines and standards to safeguard the interests of farmers and the wider agricultural sector.

Funding research and development initiatives to promote innovation and adaptation of automation in agriculture was strongly advocated, as indicated by 91% of participants agreeing or strongly agreeing. This suggests that investing in research and development is essential to drive the sector's advancement and effective utilization of automation technologies. Establishing knowledge-sharing platforms and networks to facilitate information exchange and best practices in automation implementation was strongly supported, with 90% of respondents agreeing or strongly agreeing. This emphasizes the importance of creating platforms for farmers, experts, and stakeholders to collaborate and share insights for successful automation implementation. Encouraging public-private partnerships to promote technology transfer and adoption in the agricultural sector received strong support, with 88% of participants agreeing or strongly agreeing. This finding suggests that collaboration between public and private entities can accelerate the adoption and diffusion of automation technologies.

Conducting awareness campaigns to educate farmers about the benefits and opportunities associated with automation was seen as important, with 85% of respondents agreeing or strongly agreeing. This highlights the need for targeted campaigns to increase awareness and understanding of the potential of automation in improving agricultural practices. Lastly, prioritizing supportive infrastructure, including reliable power supply and internet connectivity, was strongly advocated, as indicated by 92% of participants agreeing or strongly agreeing. This underscores the importance of investing in the necessary infrastructure to implement and utilize automation technologies effectively.

8.1 Discussions

The findings of this study shed light on the impact of automation on agricultural productivity and resource efficiency in Kenya. The results indicate that automation has significantly improved the overall productivity of agricultural activities, with a large majority of respondents agreeing or strongly agreeing. This finding aligns with previous research highlighting the positive effects of automation on agricultural efficiency and output. Farmers can optimize their operations, reduce labor requirements, and increase overall productivity by automating tasks. Furthermore, the study aligns with Greatrex et al. (2015); Onsomu et al. (2022) studies that revealed that automation has enhanced resource utilization and efficiency in the agricultural sector. Most participants agreed that automation has led to more effective practices, enabling farmers to maximize the use of resources such as water and energy. This finding aligns with the growing emphasis on sustainable agricultural practices and the need to optimize resource consumption.

In addition to increased productivity and resource efficiency, automation has brought about other significant benefits. The respondents agreed that automation had reduced the time required to complete agricultural tasks. Farmers can save valuable time and allocate resources to other critical aspects of their operations by automating repetitive and time-consuming activities. The findings also highlighted the role of automation in improving the accuracy and precision of agricultural processes. Automation technologies allow for more precise execution of tasks, reducing errors and enhancing overall quality. This finding underscores the potential of automation to improve product consistency and meet market demands for high-quality agricultural products.

Moreover, automation was found to influence crop yields and production outputs positively. Farmers can optimize cultivation practices, monitor crop health, and make informed decisions to maximize yields by leveraging automation technologies. This finding suggests that automation has the potential to enhance agricultural productivity and contribute to food security significantly. Furthermore, automation has facilitated better inventory management and improved supply chain operations. By automating these processes, farmers can streamline their logistics, reduce waste, and ensure timely delivery of products. This finding highlights the broader impact of automation on enhancing the efficiency of agricultural value chains.

The study also revealed that automation has improved pest and disease control in farming. By utilizing automated monitoring systems and the precision application of treatments, farmers can better manage pests and diseases, leading to healthier crops and reduced crop losses. Automation has enabled real-time monitoring and data collection for decision-making purposes. Farmers can collect accurate and timely data on various aspects of their operations, such as soil conditions, weather patterns, and crop health, using sensors, drones, and other automated systems. This information empowers farmers to make data-driven decisions and optimize their practices. Additionally, automation has played a vital role in promoting sustainable agricultural practices. By optimizing resource utilization, reducing waste, and improving efficiency, automation contributes to a more sustainable and environmentally friendly agricultural sector. This finding aligns with the global push toward sustainable development and the need to mitigate the environmental impact of agriculture.

Furthermore, inadequate infrastructure, including unreliable electricity and internet connectivity, limited automation implementation. Addressing this challenge requires investments in rural infrastructure to ensure the seamless integration and functioning of automation technologies. Resistance to change and reluctance to adopt new technologies were also identified as barriers. Overcoming this challenge requires targeted awareness campaigns to educate farmers about the benefits and potential of automation, dispelling misconceptions and fostering a positive attitude towards automation. By showcasing successful case studies and providing evidence of the long-term benefits, farmers can be encouraged to embrace automation as a transformative tool in agriculture. Lack of awareness and information about the benefits and potential of automation emerged as another challenge. To address this, educational campaigns and knowledge-sharing platforms should be established to inform farmers about the advantages of automation in improving agricultural practices, enhancing productivity, and opening up market opportunities.

Limited access to financing options for farmers to invest in automation was recognized as a significant hurdle. Developing financial mechanisms specifically tailored to automation investments can help alleviate this challenge. This may include providing loans, grants, or subsidies to support farmers acquiring automation technologies and equipment. Compatibility issues between different automation systems and software were identified as barriers to implementation. Standardization and interoperability of automation technologies should be prioritized to ensure seamless integration and operation across different platforms. This can facilitate farmers' adoption and integration of automation solutions, reducing technical barriers.

Uncertainty regarding the return on investment and long-term benefits of automation influenced adoption decisions. Providing evidence-based case studies and success stories showcasing automation's tangible benefits and economic returns can address these concerns and reassure farmers considering automation adoption. Finally, regulatory constraints and unclear policies related to automation in agriculture were recognized as barriers for farmers. Clear guidelines and supportive policies should be developed to facilitate the agricultural sector's adoption and integration of automation technologies. This includes ensuring automation technologies' safety, quality, and ethical use and addressing legal or regulatory obstacles that may hinder adoption.

9.0 Conclusions

The findings of this study highlight the significant impact of automation on agricultural productivity, resource efficiency, value addition, and market opportunities in Kenya. Automation has been found to enhance the overall productivity of agricultural activities, improve resource utilization and efficiency, reduce task completion time, and increase the accuracy and precision of agricultural processes. It has also positively influenced crop yields and production outputs, streamlined inventory management and supply chain operations, improved pest and disease control, enabled real-time monitoring and data collection and promoted sustainable agricultural practices. These findings underscore the potential of automation to revolutionize the agricultural sector in Kenya and contribute to food security, economic growth, and environmental sustainability.

However, the study also identified several challenges and barriers to the widespread adoption of automation in agriculture. Limited access to affordable automation technologies, insufficient technical knowledge, and skills among farmers, high initial investment costs, inadequate infrastructure, resistance to change, lack of awareness and information, limited access to financing options, compatibility issues, uncertainty regarding return on investment, and regulatory constraints were identified as the key hurdles. These findings are in line with studies of Kelemu et al. (2015), Dinesh (2016), and Rakhman (2021). These challenges require implementing policies and interventions, including government incentives and subsidies, capacity-building programs, collaborative efforts between stakeholders, affordable financing options, regulatory frameworks, research and development funding, knowledge-sharing platforms, public-private partnerships, awareness campaigns, and infrastructure development.

By addressing these challenges and implementing the recommended policies and interventions, Kenya can unlock the full potential of automation in agriculture and harness its benefits for farmers, the agricultural sector, and the wider economy. Automation can empower farmers, enhance their competitiveness in the market, improve product quality and standardization, facilitate market access and diversification, create value-added products, and strengthen agricultural value chains. Ultimately, embracing automation in the agricultural sector can contribute to sustainable development, increased productivity, and improved livelihoods for farmers in Kenya.

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DESIGN AND DEVELOPMENT OF AN E-COMPETENCE FRAMEWORK (E-CF) FOR A RESILIENT AND SUSTAINABLE E-LEARNING TVET ECO-SYSTEM IN KENYA.

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ABSTRACT

The sharp rise in the COVID-19 disease saw the World Health Organization declare it as a pandemic on 11th March 2020. On confirmation of its first positive case the Kenyan Government through a series of executive orders undertook proactive measures to contain the pandemic. One of those measures was the indefinite closure of schools, universities and TVET institutions to minimize person-to-person infection of COVID-19. This disruption of the normal training and learning process necessitated the Kenyan government to directed TVET institution to adopt e-learning as an innovative and alternative mechanisms of curriculum coverage. However, the nature of Competence Based TVET (CBET) curriculum used in TVET demands a practical hands-on approach of skills acquisition and development. Hence questions have been raised on the effectiveness of a 'virtual' curriculum coverage methodology as a means of training heavily practical and hands-on subjects. The objective this study was therefore to investigate the effectiveness of e-learning as a means of TVET training, identify the challenges and make recommendations necessary for its successful integration into TVET. Data was collected through questionnaires and interviews with 375 trainers and Trainees from different TVET institutions. The researchers were able to examine and analyze TVET trainers' experience in the implementation of e-learning during COVID-19 pandemic. These findings were categorized into e-learning knowledge, skills and competencies; 1) Already possessed by TVET trainers and 2) The gaps hindering delivery of quality e-learning programs. Based on these findings the researchers identified five key skills and competencies required by TVET trainers and also developed an E-Competence Framework (E-CF) for the delivery of quality e-learning programs.

Keywords; CBET, Framework, competencies and virtual learning,

INTRODUCTION

1.1 Background of the Study

- The sharp rise in the COVID-19 disease case load across all continents saw the World Health Organization (WHO) declaring it as a pandemic on 11th March 2020. After confirmation of its first positive case the Kenyan Government through a series of executive orders took a number of proactive measures aimed at containing the pandemic. One of those measures was the indefinite closure of schools, universities and TVET institutions so as to avoid person-to-person contact blamed as the primary driver of COVID-19 infections.

- This disruption of the normal training and learning process necessitated training institutions to adopt innovative, alternative mechanisms of curriculum coverage.

1.2 Statement of the Problem

- TVET institutions employed e-learning as an alternative route of teaching and learning. However, the nature of competencies based TVET (CBET) curriculum demands a practical hands-on approach of skills acquisition and development.

- This presented a major challenge with questions being raised on the effectiveness this virtual curriculum coverage methodology as a means of training heavily practical and hands-on subjects.
- The objective this study was therefore to investigate the effectiveness of e-learning as a means of TVET training, identify the challenges and propose a competency framework for a resilient and sustainable e-learning TVET eco-system in Kenya

1.3 Theoretical framework

The two theories that supports e-learning are Connectivism and Online Collaborative learning. The two theories are built on the cognitive science principles that demonstrate how the use and design of educational technology can enhance effective learning (David, 2015; Wang, 2012)

1.4 Rationale/ Justification/ Significance of the Study

It is believed that the findings of the study proposed and the proposed E-learning Competency Framework (E-CF) will;

- Boost the management of TVET in decision making ability by making sure that resources are spent on the right aspect as far as achievement of eLearning is concerned.
- Be relevant to the ministry of higher education in Kenya in that it will highlight the role of ICT in the implementation of ELearning in TVET institutions.
- Create awareness among stakeholders about the importance of ICT as a training enabler.
- Enrich the existing literature review data bank on the role of ICT in the implementation of online training. Also, the study will also be useful to future researchers who would wish to expound on the challenges on implementation of online learning in Kenya and form a basis for further research work.

2.0 LITERATURE REVIEW

2.1 Recent Works on E-learning

E-learning is becoming an increasingly major component in the teaching and learning in the TVET institutions. As Li and Hart (1996) and Lin (2006) pointed out, e-learning is becoming more and more popular with learners because they can combine their learning experience together with the advancement of information technology. Wanjala, Khaemba and Mukwa (2011) proposes that institutions to adopt ICT utilization in education because these technologies have been recognized worldwide as tools that facilitate and enhance the teaching and learning process through various ways like providing universal access to learning resources. Adoption and use of ICT in schools can promote collaborative, active and lifelong learning, increase trainees' motivation, offer better access to information and shared working resources, deepen understanding, help trainees think and communicate creatively (Khan, Hasan & Clement, 2012). Ariwa and Rui (2005) point out that e-learning has become the protagonist for change in education sector. It is seen as a cost effective approach to facilitating learning to large groups using information and communication technology.

2.2 Goals and Benefits of E-learning

The main goal of E-learning is to overcome the barrier of place and time and offer flexibility of content delivery to the learner that suits their individual needs thus improving the effectiveness of learning.

The benefits of E-learning compared to the traditional/conventional methods of learning among many others are;

i. The content can be assessed by the trainee at any time unlike in face to face where ,once the lesson is missed ,the trainee has to find ways or recovering

ii. Economical as the trainee does not spent much time on accommodation or travel.it also reduces the cost of buying or photocopying resource materials as these are delivered in soft copies

iii. Access to other training opportunities.it is now possible for a trainee to concurrently attend to other courses

iv. The trainer has more time to effectively deal with questions that have been sent via chat or messages

v. Other benefits include: time and money savings, higher engagement & retention rateseasier scheduling and deployment and enhancing competitiveness

2.3 Approaches to e-learning services

Choosing the right eLearning Methods, totally depends upon the proper need analysis of the organization and upon the nature of the audiences and their collaboration methods. Knowing all of the benefits of choosing the right eLearning methods for your needs, you may want to think about implementing it when designing your next eLearning course. It can not only make the development process more streamlined and productive, but it will also provide a better eLearning experience for your audience.

Examples include Self-study, Video/audio tape, Computer-based training (CBT) , Web-based training (WBT), Blended eLearning /Instructor-led (ILT), Mobile Learning, Social Learning, Simulation,

3.0 RESEARCH METHODOLOGY

3.1 Study Design

This research adopted the mix methods approach, namely descriptive qualitative approach and descriptive quantitative approach. The researchers administered descriptive qualitative research method to measure the effectiveness of e-learning, meanwhile the descriptive quantitative method applied to investigate trainer's and trainee's perception on the challenges faced.

3.2 The Study Population

According to Mugenda and Mugenda (1999) a target population is that population which the researcher wants to generalize results. The study was conducted among the Trainers and Trainees of TKNP.

3.3 Sample and Sampling Technique

The study used proportionate Stratified random sampling. Using this approach, the entire trainee's population was divided into multiple non-overlapping, homogeneous groups (strata) based on their departments. Each stratum (department) sample size is calculated using the same sampling fraction and hence directly proportional to the population size of the entire population of the department. The researchers then randomly choose final members from within the various departments for the research.

3.5 Description of Data Collection

The primary instrument for data collection will be questionnaires. In order to obtain data on the effectiveness and challenges of e-learning on trainee's learning and teachings in TVET post-secondary institutions, online (electronic) questionnaires were designed and distributed to 362 trainees and 13 Trainers from various TVET institutions. This method of data collection was chosen as it best fitted into the Ministry of Health regulations and recommendations on the containment of the COVID-19 pandemic through the minimization of person to person contact and the use of paper.

The online survey questionnaires were designed on google forms and consisted of three sections:

- The first part was the demographic and occupational data composed of 4 questions related to gender, age, department, and specialization/or course being undertaken
- The second part was testing on quantitative data on the factors of effectiveness and collected from the 10-item close-ended questions of five-point Likert scale (1= Strongly Agree, 5= Strongly Disagree) statements in the survey;
- The third part was the qualitative data gathered from an open-ended question on the challenges and barriers of e-learning on teaching and learning.

Technology Acceptance Model (TAM) was used to validated the online questionnaire. TAM is an information technology framework for understanding users' adoption and use of emerging technologies. The model states that a person's intent to use (acceptance of technology) and usage behavior (actual use) of a technology is predicated by the person's perceptions of the specific technology's usefulness (benefit from using the technology) and ease of use (Davis FD, Bagozzi RP, Warshaw PR, 1989).

3.6 Validity and Reliability

Cudeck and O'Dell (1994) recommends the use of a pilot study to test the reliability and validity of the questionnaire. The questionnaire was circulated among 22 respondents (10 teachers and 12 trainees), from various departments and Cronbach's alpha used to measure the internal consistency of the variables in each factor so as to determine the reliability of the questionnaire (Cronbach, 1951). Whereas a Cronbach's alpha of 1 indicates the highest correlation, A test instrument is declared to be valid based on the reliability index if the value of Cronbach Alpha is 0.7 or more. For our questionnaire the alpha was found to be 0.832 for the Trainer's questionnaire and 0,801 for the trainee's questionnaire. This result indicated as acceptable level to proceed further with the study.

3.7 Data Collection Procedure

The telephone numbers and email address of the targeted trainers were obtained. A WhatsApp group for the trainers was formed and the link to the online questionnaire sent to the WhatsApp group. The link was also sent directly as SMS to their phone numbers and also to their email addresses.

The link was circulated to the targeted trainees through their respective heads of departments who administers their WhatsApp group accounts.

The results were automatically collected in the research group's Gmail account (research.2022@gmail.com) specifically registered for the purpose of data collection.

3.8 Data Verification

Triangulation is a process of data verification that involves cross-checking of information to ensure that the findings agree with or are not contradicted by independent measures (Miles and Huberman, 1994). There are several methods of triangulation such as data source triangulation, methodological triangulation, theoretical triangulation and researcher or investigator triangulation.

In this research investigator triangulation method was used, this was done by dividing the research group into 2 different teams and each team given the same data to analyze and their results / findings compared.

3.9 Methods of Data Analysis

The response from the questionnaires were examined using qualitative analysis and quantitative analysis

Miles and Huberman (1994), defined qualitative analysis as consisting as three current flows of activity that is data reduction, data display, and conclusion drawing/verification. This is the model that was applied by the researchers on the qualitative data addressed to the research objectives. Meanwhile, quantitative data was analyzed with descriptive statistics using SPSS software and summarized into tables, bar graphs and tables

3.10 Ethical Considerations

The research was undertaken after permission had been sought from the office of the Principal of The Kisumu National Polytechnic through the Head of Department Research and Innovations. The target respondents were given adequate explanation on the purpose of the research and thereafter given time any questions or seek clarification. All the respondents were taken through the required informed consent procedures.

4.0 DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 Socio demographic characteristics

4.2.1 Age and Gender of respondents

Respondents of all ages (18 through to over 40) were represented, with slightly larger numbers in the age bracket 15-19, 20-24 and 25-29 categories accounting for 79 (21.07%), 147 (39.20%) and 91(24.27%) of the respondents, respectively (Table 4.1). The oldest age bracket was 40 years and above which accounted for 8 (2.3%) of the respondents.The proportion of ages of males to females was about 56.53% and 43.47% in all age groups

4.2.3 Level of Study of Respondents

The trainee respondents sampled were from diploma, craft, and artisan and CBET programs. Diploma level accounted for the highest number of respondents at 199 (54.97%), Craft had 101 (27.9), artisan 53(14.64%) and CBET had 9 (2.49%) of the respondents

4.2.5 Level of education for trainers

Most studies indicate that there is a positive relationship between education and knowledge and practices of people. Educational levels of the respondents are presented in figure 4.2 above. Amongst the trainer respondents sampled those with bachelors' level of education were the highest at 6 (54.55%), Masters had 2 (18.18%), Diploma had 2 (18.18%) and Doctorate had 1 (9.09%) of the respondents

4.3 Challenges hindering the effective implementation of e-learning

To comprehensively identify and investigate the Challenges hindering the effective implementation of e-learning three variables were considered: academic challenges, technological challenges and administrative challenges. The data from the administered questionnaires were analyzed using quantitative methods, and calculations of central tendency were performed for each item. The results indicated that the academic

challenges component had an overall mean of 4.28 and a standard deviation of 0.09. This indicated that most of the respondents tended to moderately agree that they faced academic challenges when using the E-learning system. The lack of knowledge on how to develop E-learning content had the highest mean of 4.57. Furthermore, the lack of time for online exams/assignments preparation, the lack of enough contact time between trainees and teaching staff, and the inaccessibility of course notes/materials from the E-learning platform had an approximate mean of 4.40. The lowest mean (3.62) was observed for the lack of time for E-learning content development.

4.3.2 Technological challenges hindering the effective implementation of e-learning

The finding indicates that technological challenges hindering the effective implementation of e-learning has an overall mean of 4.03 and a standard deviation of 0.09. This indicates that most of the respondents tend to moderately agree that they faced technological challenges when using the E-learning system. Lack of knowledge on how to develop E-learning content and Lack of money for purchase of internet bundles had the highest mean of 4.42. Furthermore, Insufficient Internet connectivity / bandwidth, lack of technical support and difficulty in using the E-learning system rank highly with mean between 4.16 and 3.19. The lowest mean (3.71) indicates that most of the respondents were neutral on whether lack of computers/laptops/ phones for accessing the E-learning system was a challenge.

4.3.3 Administrative challenges hindering the effective implementation of e-learning

Administrative challenges hindering the effective implementation of e-learning had an overall mean of 2.94 and a standard deviation of 0.12. This indicates that most of the respondents tend to moderately disagree that they faced administrative challenges when using the E-learning system. Negative attitude towards E-learning had the highest mean of 4.15 Furthermore, Lack of financial support for E-Learning had a mean between 3.25. Most of the respondents were disagreed that Lack of financial support for E-Learning and Lack of administrative support were challenges

4.4 Mitigation measures to the challenges facing e-learning.

4.4.1 Mitigation measures to the administrative challenges facing e-learning.

250 trainees and 6 trainers proposed capacity building, while outsourcing was proposed by 58 trainees and 7 trainers. 165 trainers and 5 trainers proposed increase in budgets lines. The highest number of Trainees 301 proposed is to provide more eLearning materials and equipment. The trainers who proposed it were 5.

4.4.2 Mitigation measures to the technology challenges facing e-learning.

200 trainees and 9 trainers proposed acquisition of more hardware, while acquisition of more hardware was proposed by 160 trainees and 9 trainers. 42 trainers and 4 trainers proposed securing more budgets to finance infrastructure. 182 Trainees and 9 trainers provision of technical support.

4.4.3 Mitigation measures to the academic challenges facing e-learning.

210 trainees and 7 trainers proposed capacity while improving of attitude trainers and trainees' attitudes were 5 and 6 ,170 and 158 respectively/. Development of eLearning policy as proposed by 170 trainees and 7 trainers.

5 SUMMARY OF FINDINGS, DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of Main Findings

The Key findings were

1. There were administrative challenges affected eLearning effectiveness
2. There were technological challenges affected eLearning effectiveness
3. There were academic challenges affected eLearning effectiveness

5.2 Discussion of Results

5.2.1 Administrative challenges of eLearning

This study presents, administrative challenges of teaching staff are inadequate ICT and E-learning infrastructure, problems with internet access, lack of administrative encouragement and some negative attitudes towards E-learning. It observes clearly that the inadequate of E-learning is the most critical factors to full implementation of successful E-learning. The Kisumu National Polytechnic has substantial infrastructure in ICT and E-learning. It provides adequate technological infrastructure, including network connections and computers, and technical support for both trainees and teaching staff. Therefore, the problems with internet access or other administrative issues solved through the implementation of E-learning. Lack of some teaching staff or trainees' knowledge about E-learning who have the literacy of computer skills and the internet has negative comments/viewpoints.

5.2.2 Technological challenges of eLearning

It revealed the technical challenges faced by trainers include a lack of technical support/advice, lack of training courses, technical background, home internet access, and adaptive technology. Therefore, some teaching staff has basic computer literacy skills. However, these skills may not be adequate to use E-learning in teaching as well as developing e-content, so teaching staff needs technical support, training and access to the internet.

5.2.3 Academic challenges of eLearning

It observed that the academic challenges of trainers and trainees are the time required to exams/assignments, the way of interaction between trainers and trainees, and inaccessibility, of course, notes/materials. The study revealed that online exam or assignments take a limited time of short duration to avoid these challenges. As a result, most trainees are busy with the routine of daily life, studying and homework or fun. The benefit is that trainees easily can get their marks at the same time. It can do at any time and place. Trainees also can check and study their course materials anywhere and anytime as well

5.3 E-learning Competence Framework (E-CF)

E-CF sets to provide a **common language** to describe the competencies, skills and knowledge requirements of TVET trainers for a resilient and sustainable e-learning TVET eco-system in Kenya.

The competencies included in the Proposed E-CF have emerged from responses received to the research sub-question on the mitigation measure to challenges facing e-learning

The E-CF presented in this paper was developed to:

- Recognize individual contributions, skills, and knowledge towards e-learning
- Reflect the knowledge, skills and competency needs of Kenya TVET trainers in line with their qualifications, needs, culture, and students' learning requirements.

5.3.1 The Propose E-learning Competence Framework (E-CF)

a) A positive attitude towards e-learning.

- Trainers should believe in the positive impacts that e-learning
- have a positive attitude towards change and a willingness to use new tools and technologies to adapt to new situations.
- A positive attitude towards e-learning can also build confidence, readiness, positive expectations, and ability to perform.

b) Creativity in using digital tools.

- Trainers need to be made aware of the many tools and applications for e-learning available and which can be used to perform educational tasks and deliver theoretical and practical skills training.
- Creativity is also necessary for finding new ways of teaching subjects, such as games, videos, interactive tools, Artificial Intelligence and Augmented Reality.
- Creativity is also needed for teachers to make the best use of whatever tools are available to students.

c) Communication skills.

- Strong communication skills are necessary for trainers to be able to assess students' competency levels, manage student behavior, keep students engaged, and encourage and motivate students during online lessons.

d) Preparation skills.

- Trainers need to know how to prepare students before online lessons.
- Good online teaching preparation involves not only sharing documents, but also providing feedback, answering questions and devising methods for controlling student behavior during lessons.

e) Facilitation skills.

- The ability to manage classes and student learning online is a vital skill that goes beyond just understanding how to use digital tools.

f) Leadership skills.

- The ability to "empower learners" by making them feel included and providing them with a sense of ownership of the learning process is another important skill

g) Time management skills.

- Trainers need to manage lessons and convey learning content in a limited time period.
- Time management skills are also necessary for teachers to prepare for online sessions before they start, to make sure students arrive on time and lessons begin on time.

h) Assessment.

- Trainers must use online tools and methodologies for assessing, grading and providing feedback to students, within the constraints of the ICT tools and instruments that are available.

5.4 Conclusions

It may be concluded that despite the challenges experienced in the implementation of eLearning, the process can be made more effective by adopting the proposed E-CF

5.5 Recommendations

This study recommends the consideration of the proposed E-CF by the relevant agencies/ stakeholders with a view of moving it to the next level

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Effects of Airbnb Listings, Price Differentials and Price Dispersion on RevPAR of Star-Rated Hotels in Nairobi, Kenya

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ABSTRACT

Airbnb is an innovative disruptive technology whose incremental growth is causing concerns in the hotel industry due to its perceived effect on hotel performance. While various studies have been conducted to examine the effect of Airbnb on the performance of hotels, most of these studies have been conducted in developed countries with inconclusive results reported. Despite the proliferation of Airbnb in Kenya and particularly in Nairobi, their effects on the financial performance of hotels have not been established. This study, therefore, investigated the effect of Airbnb on the RevPAR of star-rated hotels in Nairobi County. Anchored on disruptive innovation theory, the study adopted a quantitative research approach and correlational research design. The sample consisted of 573 Airbnb active rentals randomly selected from 12,336 active rentals listed on airbnb.com and all the 53 three-five-star hotels in Nairobi County. The study used panel data from Quarter 2 of 2012 to Quarter 1 of 2023. The data was obtained from selected government reports, AirDNA and Airbnb.com. The data was analyzed econometrically using STATA v.14. The results indicate that Airbnb listings, price differentials and Airbnb price dispersion had a combined significant effect on the RevPAR of star-rated hotels in Nairobi County ($R^2 = 22.45$). While the initial entry of Airbnb in Nairobi County had no significant effect on the RevPAR of star-rated hotels in Nairobi County, the proliferation of the same over time in Nairobi County affected the financial performance of the star-rated hotels. The results indicate that an increase in Airbnb listings within Nairobi County reduced the RevPAR of star-rated hotels by 0.022%. The study results imply that the initial entry of Airbnb in a market may seem not to be an issue of concern to proprietors of star-rated hotels but its continued influx in the same market has got financial implications. The findings of this current study add to the existing body of knowledge by contributing to the debate on Airbnb and hotel performance. The findings also provide informative and insightful facts that will aid in the operations of both hotels and Airbnb rental facilities.

Keywords: Airbnb, RevPAR, Star-Rated Hotels, Nairobi, Kenya

15. INTRODUCTION

Technologies have significantly affected how hospitality businesses operate in today's dynamic business environment (Obonyo, 2016). In particular, digital technologies in the form of disruptive technologies have significantly impacted the operations of the hotel industry and in turn performance (Ivanov, Seyitoğlu & Markova, 2020; Lenuwat & Boon-itt, 2021; Iranmanesh et al., 2022). Key among the disruptive technologies in the hospitality industry worldwide is Airbnb (Hall et al., 2022; Dogru et al., 2020; Adamiak, 2019; Roma,

Panniello & Nigro, 2019; Dogru, Mody & Suess, 2018; Lutz & Newlands, 2018; Mody & Gomez, 2018; Mody, Suess & Lehto, 2018).

Airbnb which stands for air, bed and breakfast is defined as "… an online platform that gives people around the world (hosts) the opportunity to rent out accommodation property as a hospitality service for which they receive a fee" (Janssens, Bogaert &Van den Poel, 2021, p. 1). This innovative product operates on a sharing economy platform (Hall et al., 2022; Destefanis, Neirotti, Paolucci and Raguseo, 2020; Gössling and Hall, 2019) which enables people to collaboratively share and make use of underutilized resources, including include rental houses, apartments, single rooms, boats or even treehouses for a fee (Roma et al., 2019; Kanja, 2018). Officially launched in 2008 by Joe Gebbia, Nathan Blecharczyk and Brian Chesky, Airbnb operations have increased exponentially hitting over $180 billion in revenues that are spread through over 4 million hosts worldwide as of December 2022 (Airbnb, 2023). Airbnb is now the largest peer-to-peer platform in the hospitality industry (Hall et al., 2022; Yang et al., 2022; Dogru et al., 2020) with over 6.6 million active listings in over 220 countries providing accommodation temporarily to over 1.4 billion travellers (Airbnb, 2023).

Africa is considered the fastest-growing destination for Airbnb business with over 3.5 million bookings (Kanja, 2018). A report by Airbnb shows that out of the eight fastest-growing destinations for Airbnb guest arrivals, three are located in Africa with Nigeria leading, followed by Ghana and Mozambique in that order. Kenya, compared to Nigeria at 213%, had a 68% increase in bookings through Airbnb listings. Airbnb as a disruptive technology entered the Kenyan market in 2012 and has since grown over time. This growth is mainly seen in Nairobi which recorded the highest number of active rental listings of 12,336 in the first quarter of 2023 compared to other regions in Kenya (AirDNA, 2023; Airbnb 2023).

Although in its early years, Airbnb was believed not to compete with traditional hotels (Mody and Gomez, 2018), its success over the years is continuously caused worries to traditional hotel proprietors (Hall et al., 2022; Hollander, 2022; Yang et al., 2022; Coles, 2021; Dogru et al., 2020; Prayag et al., 2020; Qiu et al., 2020; Roma et al., 2019; Adamiak, 2019). As a result, a growing body of research (e.g., Dogru, Mody, & Suess, 2018, 2019; Dogru, Hanks, Ozdemir, Kizildag, Ampountolas, Demirer, 2020; Dogru, Hanks, Mody, Suess & Sirakaya-Turk, 2020; Haywood et al., 2017; Benítez-Aurioles, 2019; Dogru, Mody & Suess, 2017b; Zervas et al., 2017; Xie & Kwok, 2017) has been dedicated to understanding the impact of Airbnb on hotel performance in various parts of the world using financial measures such as occupancy rates (OCC), revenue per available room (RevPAR) and average daily rate (ADR). While a set of these research, mainly those done in the US hospitality market (e.g., Dogru et al., 2020; Dogru et al., 2018; Dogru et al., 2019; Roma et al., 2019; Destefanis et al.,2020; Hajibaba and Donlicar, 2017; Zervas et al., 2017; Guttentag, 2015; Benítez-Aurioles, 2019) have reported negative effects of Airbnb on hotel performance, another set (e.g., Borysiewicz, 2017; Yang and Mao 2020; Heo, Blal, and Choi 2019; Strømmen-Bakhtiar and Vinogradov 2019; Aznar et al. 2017; Blal, Singal & Templin, 2018) has shown that Airbnb does not present a significant threat to hotel performance.

While several studies have investigated the effect of Airbnb on the performance of incumbent hotels as evidenced by the foregoing discussions, their findings are contrasting and inconclusive. Many of these studies were also mainly specific to certain geographical markets in the US and some parts of Europe and Asia and therefore lack generalizability. These markets also present differing contextual setups from the Kenyan market. According to Adamiak (2019), Airbnb isn't a uniform segment and as such its effects on hotel performance would vary depending on the territorial context. There is also a lack of study of this nature in the Kenyan Market despite Airbnb listings in Kenya, particularly, Nairobi experiencing exponential growth over time. This study therefore aimed at investigating the effect of Airbnb on the financial performance of star-rated hotels in Nairobi, Kenya. Specifically, the study sought to determine the effect of Airbnb listings, Airbnb price differentials and Airbnb price dispersion on revenue per available room (RevPAR) of star-rated hotels in Nairobi County. In this regard, the following hypotheses were advanced:

H_{01}: Airbnb listings do not have a negative significant effect on the RevPAR of star-rated hotels in Nairobi, Kenya

H_{02}: Airbnb price differentials do not have a negative significant effect on the RevPAR of star-rated hotels in Nairobi, Kenya

H_{03}: Airbnb price dispersion does not have a negative significant effect on the RevPAR of star-rated hotels in Nairobi, Kenya

16. LITERATURE REVIEW

2.1 Airbnb and Hotel Industry Performance

Hotel industry performance has been a subject of discussion among various researchers worldwide. Performance in this case has been measured using both financial and none financial measures. Hotel industry performance has therefore been attributed to several factors key among them technological innovations. Over the years, technological innovation has affected hotel industry performance in terms of its operations, and these technological innovations have been labelled disruptive technologies (Guttentag, 2015; Dogru et al., 2020, Xie and Kwok, 2017; Yang and Mao, 2020) and sustaining technologies (Guttentag, 2015).

2.1.1 Effect of Airbnb Listings on Hotel Financial Performance

As already discussed, Airbnb is one of the major disruptive technologies that is affecting the hotel industry (Adamiak, 2022; Yang et al. 2022; Hall et al., 2022; Dogru et al., 2020; Guttentag, 2015). Because of this, various studies have examined the impact of Airbnb on the hospitality industry in varied contexts with a focus on the financial implications. As such, financial measures such as occupancy rates (OCC), revenue per available room (RevPAR) and average daily rate (ADR) have been used in attempts to understand the effect of Airbnb on performance of hotels in the US markets (Dogru et al. 2018, 2019; Dogru et al., 2020; Dogru et al. 2020; Haywood et al., 2017; Benítez-Aurioles, 2019; Dogru et al., 2017b).

Dogru et al. (2018) for instance reported that an increase in Airbnb supply resulted in a decrease of RevPAR of between 2% and 4% across hotel segments (luxury hotel segment and economy hotel segment) in the US between 2008 and 2017. On a similar note, Dogru et al. (2019) analysed panel data from 2008 to 2017 to investigate the effect of Airbnb on hotel occupancy rate (OCC), RevPAR and average daily rate (ADR) metrics in the United States. Their findings revealed that Airbnb adversely affected OCC, ADR and RevPAR. Dogru et al. (2020) further investigated the effect of Airbnb listings in four major international hotel markets outside the US which included Paris, Sydney, London and Tokyo, to see whether any contrasting results would emerge. Their study, however, concluded that Airbnb listings in the studied hospitality market negatively affected hotel RevPAR. In fact, according to their study, a percentage increase in Airbnb listings would result in a hotel RevPAR decrease of between 0.016% and 0.031% in the studied markets. A similar study conducted by Dogru et al. (2017b) in hospitality markets in Boston indicated comparable results. According to their study, a 1% increase in Airbnb supply resulted in a decrease in hotel RevPAR by 0.025% and ADR by 0.02%. Similar results are also reported by Zervas et al. (2017), who using a longitudinal study of both 7361 Airbnb supply and 4006 hotels investigated the effect of Airbnb supply on hotel revenues in Texas. They contend that a percentage increase in Airbnb supply decreased hotel revenues by 0.04%. A study by Xie and Kwok (2017) in Austin, Texas further reported that increasing Airbnb supply significantly brought down hotel RevPAR. Accordingly, they attribute this to the fact that Airbnb's supply would substitute the demand for hotel rooms thereby eating into the hotel revenues. The general implication of these findings is that Airbnb supply in a given geographic region would negatively affect hotel financial performance. Roma et al. (2019) attribute this negative trend to the fact that traditional hotels would have to adjust their prices downwards to compete with Airbnb in their

locality. Despite this, the effect will be more significant in lower cadre hotels than high cadre hotels, and not all traditional hotels would feel the effect (Destefanis et al.,2020; Hajibaba & Donlicar, 2017; Zervas et al., 2017).

On the contrary, Blal et al. (2018), using a mixed model analysis reported that overall hotel RevPAR is not in any way related to total Airbnb supply in San Francisco. Choi et al. (2015), in their study, concluded that Airbnb does not significantly affect the revenues of hotels in Korea. On a similar note, STR (2016a) in their study concluded that the growth rate of traditional hotels outperformed that of Airbnb in six out of the seven markets surveyed in the USA. The implication of this is that the penetration of Airbnb does not in any way affect the performance of traditional hotels. STR (2016a) argue that tourists only sought Airbnb in situations where there were shortages of traditional accommodation service providers like hotels. In support, of STR's (2016b) analysis of Airbnb and hotel rooms in Sydney, Australia, show that less than a third of Sydney Airbnb listings are potential competitors to traditional hotels in Sydney's accommodation market. Morgan Stanley Research (2015) surveyed users of peer-to-peer networks such as Airbnb from the USA, UK, France and Germany markets and found no significant change in the market demand for traditional hotels. This therefore would not translate to any significant impact on the performance of the hotels in the markets surveyed. Choi et al. (2015) in their study in Korea also reported that Airbnb does not impact hotel revenues. They reported that most tourists surveyed in Korea preferred to check into hotels rather than check in on Airbnb. The general implication of this set of studies is that Airbnb does not in any way impact hotel performance.

2.1.2 Airbnb Price Factors on Hotel Performance

The financial performance, particularly RevPAR, of a hotel, is a function of various factors including prevailing prices in the market, location and grade or rating as well as the size of the hotel (Lee, 2016). Some authors (e.g., Zervas et al., 2017, Neeser, 2015; Roma et al., 2019; Destefanis et al.,2020; Hajibaba and Donlicar, 2017) argue that penetration of Airbnb in a given geographical region would likely impose a downward pressure on hotels average prices. In the same breath, Destefanis et al. (2020) contend that this effect would be negligible, particularly if the hotels within the same region as Airbnb are of a higher rating, implying that prices charged by such Airbnb would not in any way affect the performance of such hotels. Higher ratings hotels tend to charge higher prices for their rooms and therefore charges by Airbnb rentals in such locality would not affect the hotel performance.

On the contrary, Blal et al. (2018) argue that higher Airbnb rates would translate to higher ADR for hotels in large cities like San Francisco, hence higher RevPAR if Airbnb were to be considered a substitute product/service. The implication of this is that with higher hotel rates, then travellers would opt for cheaper Airbnb which will in turn affect the occupancy rate of hotels in such localities and this in turn would affect the performance of the hotels. Blal et al. (2018) further contend that the effect of Airbnb price factors on hotel performance would be marginal if Airbnb were to be considered a supplementary service. These findings generally indicate the relevancy of price factors such as price differentials (Lee, 2016; Kim and Hwa, 2019; Xie and Kwok, 2017) and Airbnb price dispersion (Kim and Hwa, 2019; Xie and Kwok, 2017) on the financial performance of traditional hotels in a given locality. According to Kim et al. (2016), hospitality establishments that charge higher prices than their competitors tend to have better performance in the long term. Despite the need to consider Airbnb price factors in understanding the effect of Airbnb on hotel performance, no study of this nature has been conducted in Kenya.

3.0 Research Methodology

3.1 Study Area

Data for this study were collected from star-rated hotel properties and Airbnb listings in Nairobi County. Nairobi County was considered in this study because it's a major metropolitan area that has experienced

exponential growth in vacation rentals (AirDNA, 2023). Nairobi is also ranked third, among the top cities in Africa with the highest number of listed Airbnb facilities (Airbnb, 2023). According to the tourism regulatory authority (TRA) (2023), Nairobi County also has the highest number of star-rated hotels compared to other regions in Kenya.

3.2 Research Approach and Design

The study adopted a quantitative approach where panel data was analysed quantitatively. The study employed a correlational research design to investigate the effects of Airbnb on hotel performance. The design allowed for the examination of idea development and trends using cross-sectional data collected over time (Creswell and Creswell, 2018).

3.3 Study Population

The study targets all Airbnb active rentals listings and star-rated hotels in Nairobi County. According to AirDNA (2023), there are a total of 12,336 active rentals listed on Airbnb. Nairobi county also has the highest number of star-rated hotels at 53, with ratings ranging from two-star to five-star (Tourism Regulatory Authority [TRA], 2023). These include ten 5-star hotels, nineteen 4-star hotels, fifteen 3-star hotels and nine 2-star hotels.

3.4 Sample

The study employed census to collect relevant data from all the 53, star-rated hotels within Nairobi County. For Airbnb data, Creative Research Systems (2023) formula was applied to compute the appropriate sample of Airbnb listings given the large population size. According to the formula, the required sample size for an infinite population is 600. Since the study population is 12,336 active rentals listed in Airbnb as of Quarter 3 of 2023, the sample size is reduced using the correction formula to 537. Simple random sampling was used to sample 573 active rentals listed in Airbnb from which panel data was obtained.

3.5 Data Collection

To address the research objectives, a unique panel data set relating to ADR and occupancy rate of hotels and Airbnb rentals in Nairobi County was collected over a period from April 2012 when the first Airbnb listing was recorded in Kenya to March 2023. The data were obtained from AirDNA and Airbnb.com. This was also supplemented with data obtained from government reports regarding hotel performance for the said period. Where there were variations, the average of the data was used instead**.**

3.6 Data Analysis and Model Estimation

Data were first analysed descriptively to assess the trend for both hotel RevPAR and Airbnb listings. Thereafter, Between Effect (BE) random effect with weighted least square in Stata v 14 was used to estimate the model since the panel data was unbalanced. RevPAR of the hotel i at time t was modelled as a function of Airbnb listing, Airbnb price differentials (Hotel ADR – Airbnb ADR) and Airbnb price dispersion as shown in equation

4.0 Results and Discussion

4.1 Descriptive Analysis

The descriptive results are shown in Figures 1 to 3. Figure 1 shows that there has been a progressive exponential increase in Airbnb rentals in Nairobi County over the years.

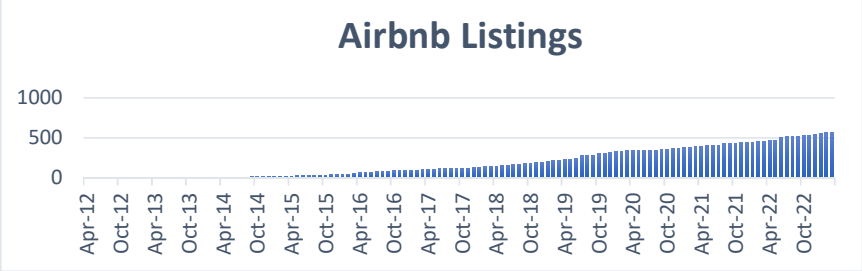

Figure 1. Airbnb listing trend between April 2012 and March 2013

Figure 2 on the contrary depicts a different trend with peaks and troughs for hotel RevPAR over the years. This kind of trend would be associated with numerous factors including the influx of Airbnb among other factors.

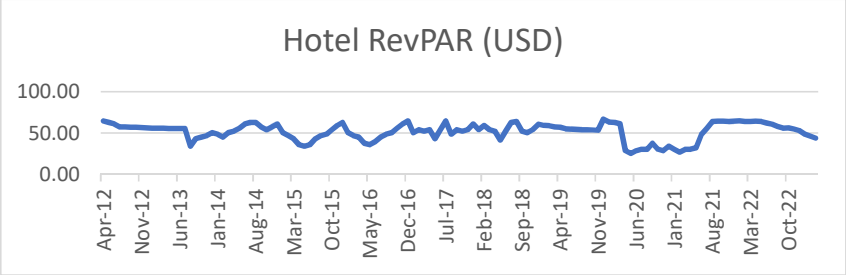

Figure 2. Hotel RevPAR trend between April 2012 and March 2023

Figure 3 on the other hand depicts a combined analysis of the two key variables. It shows that up to the round of January 2016, Airbnb supply wasn't a concern for star-rated hotels in Nairobi County since minimal impact if any could be witnessed on hotel RevPAR. However, beyond 2016, RevPAR for hotels is generally on the downward trend as Airbnb listings keep on increasing.

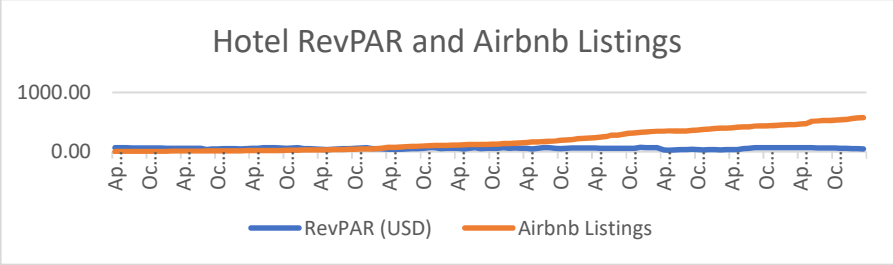

Figure 3. The trend of Hotel RevPAR and Airbnb listings between April 2012 and March 2023

4.2 Effect of Airbnb, Price Differentials and Price Dispersion on Hotel RevPAR

The three hypotheses were tested using panel regression analysis. The results indicate that the model is significant ($F [3, 60] = 6.71$, $p < .001$ with Airbnb price dispersions, Airbnb price differentials and Airbnb listings explaining 22.45% of the variation in RevPAR of star-rated hotels in Nairobi County (i.e., $R2 = 0.2245$). The regression coefficient results are shown in Table 1 and it shows that a percentage increase in Airbnb supply within Nairobi County would decrease the RevPAR of star-rated hotels in Nairobi County by 0.02%. The results also show that other than Airbnb listings in Nairobi County, Airbnb price factors such as price differentials and price dispersions negatively affect the RevPAR of star-rated hotels. All the study predictors negatively affected RevPAR thus all the null hypotheses were rejected.

The study findings imply that with the increased number of Airbnb active rentals, the travelling public is presented with options of fairly cheap accommodation facilities for their use which is accessed through peer-to-peer platforms. In doing so, they would shun conventional hotel rooms which are perceived to be expensive. This in turn would reduce hotel occupancy and affects their RevPAR. Similarly, with variations in pricing, particularly among Airbnb which charge lower rates as well as conventional hotels, hotels would be pressured to lower their rates to compete in a market that getting flooded with Airbnb rentals. The findings are similar to those of previous studies (e.g., Dogru et al., 2017b; Dogru et al., 2020) that reported a negative effect of Airbnb listings or supply on hotel financial performance. Dogru et al (2020) for instance reported that a percentage increase in Airbnb decreased hotel RevPAR by between 0.016% and 0.031% in major hotel international markets. Similarly, Dogru et al. (2017b) found that Airbnb supply decreased hotel RevPAR by 0.025% in Boston. The results contradict the findings of (Yang and Mao 2020; Heo et al., 2019; Blal et al., 2018) who contend that Airbnb does not affect hotel performance in any way. The findings further support sentiments by other researchers (e.g., Xie and Kwok, 2017) that another RevPAR is not only a function of Airbnb supply but also other contextual factors including price factors, especially when they are perceived from a competitive point of view rather than a supplementary point of view.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The study set out to investigate the effect of Airbnb listings, price differentials and price dispersion on the RevPAR of star-rated hotels in Nairobi County. The descriptive results of the study generally indicate that initially, Airbnb listings don't present any significant effect on the performance of star-rated hotels in Nairobi County. However, over time, this rhetoric changes as Airbnb listings, price differentials and price dispersions exert pressure on the RevPAR of star-rated hotels in Nairobi County, explaining about 22.45% of the variance. These effects are, however, negative implying that hotel operators shouldn't take the influx of Airbnb rentals lightly.

The study, therefore, recommends that the proprietors of star-rated hotels in Nairobi County and other parts of Kenya need to take advantage of this disruptive innovation and use it as another distribution channel platform for their hotel rooms to improve their performance over time.

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The Role of Technical and Vocational Education And Training (TVET) In The Creation of Green Jobs: The Case of Kenya

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ABSTRACT

This research study investigates the role of Technical and Vocational Education and Training (TVET) in the creation of green jobs in Kenya. With a growing global emphasis on sustainability and the transition towards a green economy, understanding the contribution of TVET in promoting environmentally friendly employment opportunities is of great significance. The study adopts a mixed-methods approach, combining quantitative analysis and qualitative interviews to gather comprehensive data. Quantitative data is collected through surveys conducted among TVET graduates and employers, focusing on the creation and availability of green jobs, the skills required in the green sector, and the effectiveness of TVET programs in preparing individuals for such jobs. Qualitative interviews are conducted with key stakeholders, including policymakers, TVET instructors, and representatives from green industries, to explore their perspectives on the role of TVET in the creation of green jobs and the challenges encountered in this process. The findings of the study reveal several key insights. Firstly, TVET plays a crucial role in equipping individuals with the necessary knowledge and skills to participate in the green economy. The study identifies specific green sectors where TVET graduates are in demand, highlighting the contribution of TVET in meeting the growing need for skilled workers in areas such as renewable energy, sustainable agriculture, waste management, and environmental conservation. The study also explores the role of partnerships between TVET institutions, green industries, and the government in facilitating skill development, job placement, and promoting entrepreneurship in green fields. The research findings contribute to the existing knowledge on the role of TVET in the creation of green jobs, providing evidence-based insights for policymakers, educational institutions, and other stakeholders involved in sustainable workforce development. The study's recommendations aim to strengthen the integration of green concepts into TVET curricula, enhance practical training opportunities, foster industry collaboration, and promote entrepreneurship in the green sector in Kenya.

Keywords: Technical and Vocational Education and Training (TVET), green jobs, sustainability, green economy, skills development, renewable energy, sustainable agriculture, waste management, environmental conservation, Kenya.

1.0 INTRODUCTION

1.1 Background of the study

Technical and Vocational Education and Training (TVET) institutions are established under the ministry of education with the mandate to train trainees preparing them for job opportunities. In an institution setup, despite the enrolment of trainees, there are trainers employed by the ministry and those by the board of governors together with subordinate staff who carry out various functions with the main focus on producing all round graduates in various disciplines of study .however gender inequalities as a social concern remains a challenge in the quest to achieve their mandate.

In recent years, there has been a global shift towards sustainable development and the promotion of green economies. As countries strive to address pressing environmental challenges and transition towards a low-carbon future, the creation of green jobs has become a critical component of sustainable economic growth. In the context of Kenya, understanding the role of Technical and Vocational Education and Training (TVET) in

the creation of green jobs is essential for fostering a skilled workforce that can contribute to the country's sustainable development goals. Kenya, like many other nations, faces environmental concerns such as climate change, resource depletion, and pollution. At the same time, the country seeks to achieve its economic development objectives and improve the livelihoods of its citizens. TVET presents a promising avenue for bridging the gap between environmental sustainability and employment generation by equipping individuals with the knowledge and skills necessary for participating in the green economy.

1.2 Statement of the problem

The transition to a green economy poses significant challenges and opportunities for developing countries like Kenya. With the increasing importance of sustainable development and environmental conservation, there is a growing demand for green jobs that promote economic growth while minimizing environmental degradation. Technical and Vocational Education and Training (TVET) institutions play a crucial role in equipping individuals with the necessary skills and knowledge to thrive in the evolving job market.

The objective of the study is to identify the sectors within the green economy where TVET graduates are in demand, evaluate the alignment between TVET curricula and the skills required for green jobs, and examine the barriers and opportunities faced by TVET graduates in accessing and securing employment in the green sector.

2.0 LITERATURE REVIEW

Technical and Vocational Education and Training (TVET) plays a crucial role in preparing individuals with the skills and knowledge required to meet the demands of the evolving job market, particularly in the context of the green economy. Green jobs, which focus on sustainable development and environmental conservation, are becoming increasingly important for countries like Kenya. This literature review aims to explore the existing research on the role of TVET in the creation of green jobs in Kenya.

Previous studies highlight the significance of integrating green skills and knowledge into TVET curricula. Green skills encompass a wide range of competencies, including renewable energy technologies, sustainable agriculture practices, waste management, and environmental conservation. By equipping TVET graduates with these skills, TVET institutions can contribute to the development of a skilled workforce that supports the transition to a green economy.

While there is a growing body of literature discussing the benefits of TVET in general, few studies specifically address its role in creating green jobs. The available literature primarily emphasizes the potential of TVET to address the skills gap and promote sustainable development. However, there is a lack of empirical evidence on the actual impact of TVET programs in Kenya's green job market.

Moreover, the literature falls short in examining the challenges and barriers faced by TVET graduates in accessing and securing green jobs. Identifying these obstacles is crucial for developing effective strategies to bridge the gap between TVET education and employment in the green sector.

To address these research gaps, future studies should explore the perceptions of TVET graduates, employers, and industry stakeholders regarding the preparedness and competitiveness of TVET graduates for green job roles. Additionally, research should investigate the alignment of TVET curricula with the specific skill demands of the green economy, as well as the effectiveness of industry partnerships and apprenticeship programs in promoting the creation of green jobs.

3.0 METHODOLOGY

The study can utilized a mixed-methods approach, combining both quantitative and qualitative methods, to provide a comprehensive understanding of the research topic. This included surveys, interviews, and documentary analysis. Gray (2004), states the target population should have some observable characteristics, to which the researcher intends to generalize the results of the study. The study a desk review methody to collect data and quality analysis method. The process involved identifying recurring themes, patterns, and insights related to the research questions.

4.0 FINDINGS AND DISCUSSIONS

Technical and Vocational Education and Training

Various terms have come to be closely linked with TVET and these include industrial arts, vocational education, apprenticeship training, occupational education, and career and technical education (UNEVOC & UNESCO-UIS, 2011). The term Technical and Vocational Education (TVE) means that "aspect of education which prepares candidates for occupations requiring manipulative skills" (Sarki, Jah, & Nankumah, 2014). Ekpenyong (2008) defined the term as that type of education which makes for entry into and successful progress within a specific occupation or job. It deals with any high school, junior, college or adult education programme where skills, attitudes and knowledge

The Curriculum and Quality of Training Provided by TVET

In order to create jobs, training forms the foundation which is necessary in problem solving in the job creation process. In other words, the training for knowledge and skills given to TVET individuals must engender those individ- uals to propose and solve problems related to human needs and desire for better living. However, experts in TVET and the industrial sector have raised questions regarding the quality of training trainees of the TVET system have received (Olaitan, Nwachukwu, Igbo, Onyemachi, & Ekong, 1999). The authors argued that because TVET programmes are haphazardly run in educational institutions, the trend has led to the production of inefficient, ineffective and unem- ployable graduates. Consequently, in the words of (Abubakar, Kazaure, & Yusuf, 2013), "Kenyan TVET sector is currently largely characterized by a problem of disconnect between the needs of Kenyan industry and the nation's output of trained technical output". Even in a developed country like the UK, with the collapse of the apprenticeship system, many young people went to school and came out without any qualifications or competence for entering the world of work or for any prospects for further training in relevant field (Senker, 2003). This situation ought to be of serious concern to all stakeholders in the TVET enterprise.

The curriculum plays a vital role in the training of individuals in the TVET system. It spells out what to teach, how to teach and what students are expected to do at the end of the teaching. Perhaps one fundamental question which stakeholders in TVET need to address is the TVET curriculum in relation to job creation for self-reliance. Have the current curricula of our various TVET programmes adequately addressed the needs and aspirations of citizens in today's world? Have the curricula adequately addressed the skills needs of individuals who opt for the TVET system? It is really disturbing that in many cases graduates of the TVET system acquired unemployable skills while in school. This development, according to Olusanya and Miller (2014), has only increased unemployment in Kenya. Therefore, apparently there is need to re-examine the TVET curriculum in our schools and colleges in the light of prevailing living conditions and other challenges. Already a call has gone forth on the need to revise the TVET Curriculum to reflect multiple intelligence from the industrial sector (Wodi & Dokubo, 2012).

In order to enhance TVET for effective job creation, the Management and Training Corporation (MTC) (2010) identified six areas that, when implemented, will lead to a successful TVET programme. These areas include relevance to the labour market, access for trainees, funding for the system and inclusion of soft skills. These areas imply that TVET curriculum and training must be provided to suit the labour market. Consequently, government and all stakeholders must provide the enabling environment for quality instructional delivery. Equally, the technical teacher trainee must utilize the opportunity provided by the training so that on graduation, he or she would be able to provide quality delivery of the TVET programme.

Who Provides Jobs for the Teeming Population?

One fundamental question which needs to be addressed in concrete terms is who provides jobs for the teeming unemployed youth? Suffice it to say that government, educational institutions, the private sector, among others, hold key stakes in employment generation for the Kenyan people. First, government has often been seen as the greatest employer of labour. According to the National Policy on Education (Federal Republic of Kenya, 2004), government is required to prepare the youth for employment by providing the required training. When the youth have received the required training, government is expected to provide employment to them. In recent years however, government has placed embargo on employment, complaining about rise in wage bill (Gayus, Manabete, Zamdayu, & Disa, 2008; Odigbo & Owaseye, 2005). This partly accounts for the reason many graduates are unemployed. The fact however, is that government remains a major stakeholder in employment generation for the Kenyan people.

Educational institutions, especially at the tertiary level, have the freedom to select, train, employ and develop their students This means that these institutions will need to make concerted effort in the training, employment and development of their students. Academic excellence needs to be rewarded appropriately. The institutions should be interested in getting feedback on how their graduates are faring in the field for the purpose of self-assessment of their training activities.

The private sector is also a major stakeholder in training and employment generation for the youth. This is felt at no better time than the present, since it has been stressed over and over that government can no longer bear all the costs of education and employment. The private sector needs to be seriously involved. Research findings have shown that the private sector's participation in funding and managing TVET is below expected standards (S. S. Manabete, 2005). However, with concerted effort, the private sector's participation in funding TVET will be apparent in the following areas: Construction of workshops and laboratories as well as examination halls, donations by alumni associations, award of scholarships to deserving students, among others (Ardyanfitri & Wahyuningtyas, 2016; Diraso, John, & Manabete, 2012; Kemdirim, 2005). These efforts will have the dual advantage of injecting new skills and knowledge to all levels of education and engendering greater competition which can lead to improved academic performance (Haruna, 2012).

Private Small and Medium Scale Enterprises (SMEs), employing five to twenty people is a worthwhile venture. If such SMEs were to spring up in every nook and cranny of Kenya, then unemployment would have been reduced to the barest minimum. However, unemployment is increasing in Kenya because, according to Odigbo and Owaseye (2005), the labour market appears to be over-saturated and the private sector is downsizing its workforce.

TVET and Small Scale Entrepreneurships

TVET trains the individual to be entrepreneurial. Perhaps one key benefit of TVET lies in what Kwami, Yaduma, and Onuh (2014) referred to as economic development. This benefit is seen where individuals are gainfully employed and become employers of labour as well, contributing to the economic development of a nation.

For many youths who are trying to set up their SMEs in order to keep body and soul together, these considerations may appear too sophisticated and difficult to achieve. However, there is no business, of whatever size or magnitude, that can throw caution to the wind and disregard the above steps. A flagrant disregard of the steps only leads to failure. This explains why many SMEs in towns and cities across Kenya fold up overnight. In this connection therefore, it is the duty of TVET to adequately educate the youth in areas like market surveys, preparing a business plan, running the capital, undertaking production and marketing the products. This will undoubtedly keep the business moving.

TVET and ICT

The role that TVET is expected to play in ICT is that of providing individuals with ICT knowledge and skills that will enable them effectively operate the ICT facilities. In our institutions of learning, there are courses that students take in ICT. But whether the training provided the individuals is adequate is a subject that needs to be examined. Be that as it may, because ICT has been globalized, the expectation now is that every citizen of any country needs to be ICT literate and ICT compliant. A lot of responsibility now rests with TVET to train and equip the citizens to achieve this objective.

Job Creation Through Agriculture

Farming is one of the traditional vocations of Kenyans and this may assume a non-formal posture. It has the tendency to alleviate poverty and deal with food insecurity (Alfred, 2014). Before the advent of oil in Kenya, agriculture used to be the mainstay of the economy. With the oil boom of the 1970s, Kenya shifted from agricultural production, towards petrol and petroleum products. Today however, it is clear that Kenya and indeed Kenyans must have a rethink of what should enhance their living standards, in the face of dwindling prices of crude oil in the international market.

A very important thing to do to arrest the current economic stalemate is to return to agriculture. Kenya is known for producing cereals (beans, cowpea and peas), roots and tubers (yam, cocyams, potatoes and cassava). There are also other crops that do well such as vegetables, oil seeds and tree crops like ground nuts, soybeans, oil palm, coconut, mangoes, orange and guava. Aside from these, there is animal (cattle, goats and sheep) rearing, poultry and fish production. In fact, it has been acknowledged that "food crop production still remains the major employer of labour..." (Usman & Inedu, 2004). What this implies is that TVET should equip individuals with relevant agricultural skills to effectively venture into food production and value addition both for themselves and the nation. If Kenyan people, especially the youth, will take on to farming, then the number of unemployed people will drastically reduce. Available information shows that on a global level, there is adequate food produced to meet the food needs of people (khanya- aicdd, 2006). The greatest challenge however, is getting the food to reach everybody. This is due either to lack of resources to acquire the food or the means to get it across to everybody

5.0 CONCLUSION

It would be unfair to end this chapter without looking at the general challenges faced by TVET for enhanced job creation. Besides the inability of government to fully support and fund TVET, this type of education, according to of (Uzoagulu, 2010) has "a chequered history of negligence, assault and encumbrances...". These instances include 1)Over-emphasis on general education; 2) Inadequate supply of machines; 3) Poor electricity supply; 4) vandalization, cannibalization and pilferage of tools and machinery; 5) Pick and drop attitude of Kenyan government; 6) Students' lethargic attitude towards technical education. These factors have had adverse effects on the development of technical and vocational education in Kenya. Consequently, TVET has been held in low esteem in Kenya over the years, and viewed only for the academically disadvantaged (Etuk, 1987). This situation calls for an urgent value reorientation.

Undoubtedly the challenge before TVET managers is enormous. There can be no substitute in pursuing the goals of TVET. If Kenya and indeed developing countries of Africa must occupy a significant place in the technological sphere, then all hands must be on deck to achieve the needed positive change. It is hoped that Kenya in particular will pay close attention to TVET for adequate job creation towards sustainable national development in this 21st century.

6.0 RECOMMENDATIONS

The researchers strongly believe that stakeholders in TVET institutions need to be informed on the importance of mainstreaming gender and social concerns in then development agenda. Both trainers and trainees need to be sensitized on the best practices of promoting equity and preventing gender based violence in institutions. Gender based academic programs should be introduced in the curriculum to promote gender mainstreaming in institutions. The government should also put in place and ensure full implementation of laws and policies that adequately protect the interests of both men and women.

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